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ASTOUNDING STORIES

Volume XIX Number 6

August, 1937

A Street & Smith Publication

Two-part Novels:

Novel:

Novelette:

Short Stories:

Science Features:

Readers' Department:

Cover by Brown. Illustrations by Wesso, Dold, Thomson, Schneeman, Hopper.

Single Copy, 20 Cents Yearly Subscription, $2.00

Monthly publication issued by Street & Smith Publications, Inc., 79-89 Seventh Avenue, New York, N. Y. Ormond V. Gross, Vice President and Treasurer; Harry W. Bonner, Vice President; Gerald H. Smith, Secretary; A. Lawrence Hansen, Assistant Secretary. Copyright, 1937, by Street & Smith Publications, Inc., New York. Copyright, 1937, by Street & Smith Publications, Ltd., Great Britain. Entered as Second-class Matter September 18, 1930, at the Post Office at New York, N. Y., under Act of Congress of March 3, 1879. Subscriptions in Cuba, Dom. Republic, Haiti, Puerto Rico and South American Countries, except The Guianas and British Honduras, $3.00 per year. To all other Foreign Countries, including The Guianas and British Honduras, $3.75 per year.

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STREET & SMITH PUBLICATIONS, INC., 79 7th AVE., NEW YORK, N. Y.

RELEASED

Beginning a two-part novel of power—the victory of mankind—then retreat——

by JACK WILLIAMSON

HELLO, universe!"

The newscaster's brisk voice, carried out on the hyperchron beam, crackled simultaneously from ten billion receivers on ten million inhabited planets.

"I speak to you from the Hall of Worlds, on Melchonor, capital planet of the G. U. I. R. (Galactic Union of Interstellar Republics). For the Galactic Council is assembling to-morrow, in the first session of this new year, 104,293 C. S. (Conquest of Space). And a battle of giants is in promise!"

The crisp words were emphasized by the animated play of the announcer's features, across the fluorescent screens of ten billion hyperchronoscopes.

"The first item on the calendar is the famous Gyroc Experiment. This proposed research, which has been hotly debated in scientific and legislative circles for many years, is coming up for final action.

"Seru Gyroc himself—discoverer of the Omega Effect and the Gyroc Tensors, the basis of the proposed experiment—is going to speak in defense of his tremendous plan to prevent the universe from running down.

"Seru Gyroc is already acknowledged the greatest living scientist of the galaxy, with nearly two hundred years of brilliant achievement to his credit. Among the latest of his triumphs is a modification of the old triterium-water longevity treatment, which is expected to add another full two centuries to the useful span of human life.

"We salute you, Seru, a giant of science!"

The newscaster bowed, on billions of screens.

"But if he wins again, universe, it won't be an easy victory! For opposed to him is another giant! The famous space cruiser *Silver Bird* is now plunging toward Melchonor. Aboard, racing to reach the Hall of Worlds in time for to-morrow's debate, is Ron Goneen, captain general of the Galactic Patrol, and late commander of the Andromeda Expedition——

"We salute you, Captain Goneen, a giant of exploration!

"A battle of giants indeed, universe! Of giants who once were friends! For Ron Goneen, in the Galactic Academy, got his first scientific training under Seru Gyroc. Now he is returning to join battle with his old professor.

"Ron Goneen holds that the Omega Experiment, if performed, will result in immediate, universal cataclysm. He is making this desperate race, in his faithful old ship—so he believes—to save the galaxy!"

The clean-featured face of the newscaster, in the billions of glowing screens, looked briefly down as he caught his breath and scanned his notes.

"Now, universe!" he cried. "Our next surprise!

"We bring you a dramatic incident from the Andromeda Expedition, enacted in our own studios under the supervision of a group of the surviving officers.

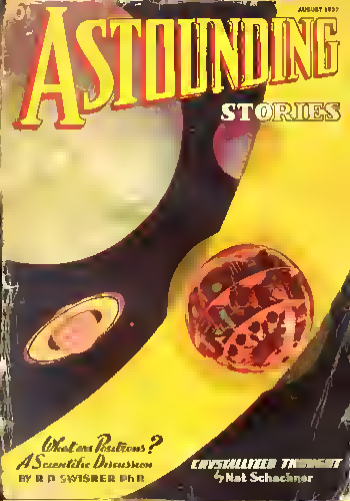
ENTROPY

Part One

"Go on, Ron," the girl was sobbing. "Leave me. Death is in me already. The black, freezing flames—they sucked out something——"

"In the three years since its return, the history of the expedition has been told many times. All humanity knows how Captain Goneen planned the *Silver Bird*—the greatest and the swiftest space vessel ever designed! How his intrepid courage found support and volunteers for the undared voyage to the Andromeda Galaxy! How the great new vessel left the yards of the Galactic Patrol, here on Melchonor, over one hundred years ago! How it reached that distant island universe after a perilous voyage of more than thirty years!

"A thousand volumes have been written of Ron Goneen's adventures during forty years of exploration among the planets of Andromeda. His discoveries there have already created a dozen new sciences. His life was in danger ten thousand times!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A Scientific Discussion
BY R. D. SWISHER PH.D.
CRYSTALLIZED THOUGHT
by Nat Schachner

"BUT NOW we depict for you the last stirring episode of that forty years, before the *Silver Bird* returned."

The animated face vanished from the screens. In its stead appeared the tapered, silvery hull of a mile-long kappa-field space cruiser, driving across a black sky whose brilliant stars were ranged in strange configurations.

"There you see the *Silver Bird*," the brisk voice resumed its narrative, "plunging ahead on the final tour of exploration, into the Gamma Quadrant of the new galaxy. There Captain Goneen encountered a new high type of intelligent life——"

Suddenly, on the myriad screens, the space about the long ship was aswarm with flying objects. They were intricate nine-pointed crystals, each many yards in diameter. Their polished planes shone with white, mirrorlike radiance. Every point carried a clinging globe of colored luminescence that spun and changed as the crystal moved.

"These beings were gigantic crystals of eternal metal. Their intelligence life, Captain Goneen believed, was a function of intermolecular electrostatic tensions; vital energy probably being derived from controlled radioactive disintegration.

"Able to cross interstellar space without the aid of machinery, they had spread over ten thousand planets in a great globular star cluster. Once—so Captain Goneen believed from the colossal ruins he saw—their civilization had been high; but their culture had long since fallen into a vicious decadence."

The screens showed the *Silver Bird* landing upon the surface of a planet, still attended by that glittering, crystalline host. On a high, age-carved plateau, against a greenish sky, loomed a weird, colossal city of crimson cones that were shattered and truncated with immemorial time.

"The metal Andromedans displayed great cleverness in their efforts to establish communication. This was soon accomplished through a radio hook-up, the crystals being sensitive to ultra-short waves and able to generate them.

"But here you see Ron Goneen himself, in conversation with a leader of the Andromedans!"

A broad-shouldered, powerful man, darkly tanned by many suns, the space captain stood on the barren ground beside his ship. Oxygen apparatus was slung about his shoulders, but his big, rugged head was bare, red hair tangled. He was speaking into a microphone. And before him, floating in a many-colored, luminous mist that clung most densely about its points, mirroring in its facets the greenish sky, was a monstrous nine-pointed star.

"At first the Andromedans pretended friendship," the staccato voice hastened on. "They brought amazing gifts, revealed the secrets of their half-lost science, and urged Captain Goneen to come with an expedition to the underground city of their rulers."

THE silvery crystals were shown bearing to the ship shining jewels, unfamiliar implements of metal, and fantastic works of art. Then, with a lonely little band in the trim green of the Galactic Patrol, Ron Goneen was seen marching away from the ship.

"It was all a treacherous plot against the explorers!" barked the newscaster. "For a simultaneous attack was made on the cruiser and the party lost beneath the surface!"

Thousands of the crystals, flying flatwise, dived slantingly at the unwarned *Silver Bird*. Jets of colored flame spurted from their points—arrowed annihilating rays that consumed scores of the luckless crew, who were caught outside the vessel. The survivors took off

hastily, in the great vessel, in an effort to defend themselves.

Deep in the planet, then, the screens showed the attack upon the other party. The Andromedans shone in the darkness—stars of mirrors, floating in cloudlets of many-colored flame! Multibeed rays, lancing from their points, ruthlessly cut down the ill-armed, helpless men as they stumbled toward the shelter of boulders and crevices.

"The few survivors," the announcer went on, "were carefully taken alive, and carried by the Andromedans into a tremendous, rock-hewn temple, many miles beneath the surface, which was the center of their degenerate worship."

The screens showed an immense dim place, with colored stars floating amid vast columns that towered into boundless darkness. Ron Goneen and a few other men, haggard and bloodstained, were kneeling in chains before a stupendous altarlike structure. Before them, set on the apex of a black cone, was a small orb of brilliant white, shimmering like some wondrous pearl.

"Proving that they had lapsed into superstitious barbarism," the newscaster rushed on, "the Andromedans chained their captives as an offering before their most holy object—a singular small round stone, which shone with a steady pale glow.

"However, they underestimated Captain Goneen!"

Slowly, the swarming crystals departed, leaving the temple dark and empty. Only the pale reflection of the jewel showed the mighty arm of Ron Goneen, as it wrenched a massive block from the altar, shattered the fetters of his companions and himself. Then the announcer continued:

"Their escape was discovered immediately," the announcer hurried on. "But Ron Goneen led the few left with him out of the temple, into a labyrinth of narrowing caverns, where the crystals were able to follow only by blasting obstacles out of the way.

"Time is lacking to detail their hardships and escapes. Flight and hiding from the pursuing crystals! Incredible privation! Desperate struggle for food and water. Respiratory difficulties from an irritating atmosphere!

"Lost for many days in the dark caverns, they made torches from a seepage of crude petroleum. Ron Goneen ingeniously contrived a compass and a barometer to guide them—from a fragment of iron ore and the hollow shell of a dead organism! When, at last, they reached the open air, he used sheets of mica to make a heliograph with which to signal the *Silver Bird!*"

The screens, again, showed the great cruiser landing beside a narrow, dark rift in the planet. Swarms of the bright crystals, wheeling high in the greenish sky, were now puzzlingly fearful of attack. The refugees, naked, weary, bruised, staggered triumphantly aboard.

And the space captain proudly held, in his great, scarred palm, a small white stone.

"The Jewel of Dawn!" cried the newscaster. "That is what Captain Goneen called the holy stone, because its pale radiance had helped guide his men through the caverns. For he had taken it from the sacred place of their captors!

"It is said that he carries it still, in a pouch under his tunic, as a memento of that most desperate adventure. Upon the expedition's return, all the other specimens and data accumulated were given to the Galactic Museum. But, although curious savants clamored for it, Captain Goneen refused to give up the stone from Andromeda!"

A great sphere, shimmering like an illuminated pearl, vanished from ten billion hyperchronoscope screens. The newscaster's face appeared again.

"That, universe," his voice crackled,

"is the history of the Jewel of Dawn. To-morrow we will take you to the Hall of Worlds, where Seru Gyroc is to speak for his proposed experiment, and Captain Goneen—if his racing ship arrives in time!—against it.

"What will be the outcome, universe? Will the Galactic Council listen to the foremost scientist of humanity, with his promises of incredible wonders to be done with the Omega Ray? Or will they give heed to this intrepid space commander and his warning of galactic doom?

"Till to-morrow, universe!"

And the ten billion screens went briefly dark.

II.

"MY OPPONENTS have said that this thing is dangerous. I grant them that ungeased perils may lurk in the unknown realms of nature which we propose to explore, but I submit that the prize justifies the risk. Man did not conquer the galaxy through fear of new discovery!"

When the white-robed speaker gravely paused, silence hung for a long instant in the vast, green-columned Hall of Worlds. Then a tremendous sea of applause rolled upward from the representatives of many interstellar dominions.

Seru Gyroc was a slight, straight man, with brilliant dark eyes and very black hair. With thin hands folded in his severely simple robe, he stood with bowed head upon the speaker's dais until silence was restored.

Quietly then, yet with a dignity supported by his supreme achievements, he resumed. "Besides that possible danger inherent in any attempt to master the very creative force of nature, the Omega Experiment will involve vast expense and will require the best efforts of our most brilliant minds—perhaps for several centuries!

"My opponents argue that it is sheer folly to undertake a project so costly in both materials and brains, so fraught with unknown peril, and—from their point of view—so needless.

"Yet, to me"—the white-robed scientist paused; his dark eyes lifted solemnly above the green colonnades, to the vast blue dome above, pricked with golden stars—"it is worth all that cost and risk to win the goal we seek—to save the universe!"

Once more wild applause rolled against the columns; and, before the thousands had resumed their seats, a powerful figure came striding through the portals: a tall man in the green of the Galactic Patrol, with stern objection written on his rugged face.

Seru Gyroc looked down with a brief smile of recognition.

"Entering is my greatest opponent, a man who was once my most brilliant student. It is strange"—and his thin face was almost sardonic—"that the fearless captain general of the Galactic Patrol should be afraid of a mere laboratory experiment! But it seems that he is. And you shall hear his reasons—and you shall judge."

RON GONEEN found a seat and sat listening, with a grim expression on his dark, weather-beaten visage.

"I respect the opinion of Captain Goneen," Seru Gyroc continued. "It was at his request, transmitted over the hyperchron beam from intergalactic space, that I ceased my preliminary experiments with the Omega Effect, thirty years ago.

"I have waited patiently for the formal approval and support of the council, because the matter is very grave.

"It is true, as Captain Goneen pointed out in his request to me, that the fate from which I seek to save our universe is very remote. Yet I venture to say that every one of you has felt the pain-

ful pressure of it! For it is supremely tragic to any thinking being to know that all his cosmos must ultimately die, even if his own life is not immediately affected.

"Our universe is running down. Eventually it must stop—die! My opponents can point out that the energy of disintegrating matter still feeds the suns, whose radiation still warms the planets with the rays that sustain all life. But they cannot deny that every phase of that vital process, being subject to the second law of thermodynamics, must at last cease to be.

"In the end, they must admit, all matter—even to the last barren fragment of the last sunless planet—must dissolve into free energy. And that energy, 'decaying' into the feeblest dark vibrations, of longest wave length, must at last be uniformly distributed through an infinitely expanded space.

"Picture that ultimate end of the universe! A void of utter darkness, of cold almost absolute, in all of which there is no possible change, no motion, no life, no thought! Even time itself must cease to be—for time is mathematically determinable only by the direction of entropy increase.

"Doesn't that vision of utter and illimitable death fill you with abiding horror—even if the reality does not touch your own lives?

"Can mankind ever be truly triumphant, living in a doomed universe?" Seru Gyroc swept his listeners with keen, dark eyes, in which burned a pressing challenge. "I feel that we cannot!

"I feel that the conquest of entropy is the supreme task of the human race, worth any cost, any risk short of sure disaster!"

When he paused, an awed and breathless silence filled the columned hall. His solemn eyes lifted slowly to the star-flung dome, and an uncertain patter of applause swept the floor. He waited. It swelled slowly to a tremendous ocean of sound, beating against the green colonnades.

Only Ron Goneen kept his seat, with the same grim expression behind the red beard on his unshaven face.

At last, when Seru Gyroc held up his arms for silence, the uproar subsided reluctantly.

Only one doubtful question rang from the floor: "Can it be done?"

III.

"IT CAN be done," said the white-robed scientist gravely. "Entropy can be mastered."

His dark eyes caught the stern, forbidding look on the face of Ron Goneen, below. He paused as if disconcerted, then caught his breath and abruptly resumed: "The first law of thermodynamics is our assurance that the dissipated energy of a run-down universe still exists. For, although energy may be expressed in many forms, from the complex atoms in the core of a young sun to the feeble, dark radiation of a dead universe, its sum total is always the same.

"It is the second so-called law of thermodynamics which informs us that any universe will run down. Yet that law has long been recognized to be merely statistical, not absolute. It is merely a statement of probability.

"Consequently, its circumvention has been the most tantalizing dream of human science. Inventors since the dawn of knowledge, vaguely sensing the hidden truth, have labored vainly to perfect machines of perpetual motion.

"There is a tradition, moreover, that a theoretical solution was imagined by an investigator whose name is now lost, at the very beginning of the Era of Science, before the race had ever left the mother planet.

"Considering the problem of a gas in a partitioned chamber, this early genius* conceived the idea of an entity he called a *demon*, who should be able to operate an ultramicroscopic door in the partition, in such a manner as to allow only the swifter-moving molecules to pass through in one direction, and only the slower-moving ones to enter the other end of the chamber.

"Thus this entity, so extraordinary of sense and agility, would be able, without doing any physical work, to accumulate fast molecules on one side of the partition, and slow ones on the other. In other words—since molecular motion is an expression of heat, of energy—the *demon* begins with a uniform or most probable distribution of energy, and he accumulates it, against the thermodynamic gradient, in one end of the chamber.

"This remarkable being, that is, reduces the entropy of this system of gaseous molecules. Without doing any work, he collects heat in a part of the system, and cools the rest. He reverses the normal flow of energy, to increase the organization of his system, and to make its energy once more available for useful thermodynamic interchange.

"How this unknown investigator pictured his *demon*," continued the white-robed speaker, "it is now impossible to say, for any other meaning of the word is lost.

"And for a hundred thousand years this elemental problem has baffled all science. The present very highly organized—and hence, statistically, extremely improbable—state of our universe has been tantalizing proof of the existence, somewhere, at some time, of this *demon*. It is evident that there must have been a winding up of the universe, a building, a creative process, in which the amount of its entropy was reduced. Yet the search for it always failed.

"The first clue, I think, is to be found in the tensors I evolved less than a hundred years ago. They constitute a complete mathematical description of that *demon*. They apply, I am convinced, to a real phenomenon possible in the material world, which I have termed the Omega Effect.

"New forces are involved, which I have termed, again using that ultimate symbol from an ancient alphabet, the Omega Radiation. I have not yet dared to release them. That waits for your approval. And their nature, therefore, or the system of laws they will follow, is yet unknown.

"Only this much is certain: the Omega Effect will alter the conditions of real probability, in whatever part of the universe in which it occurs, in such a manner that the second law of thermodynamics will no longer apply. What was formerly a state of maximum probability will become one of minimum probability, and thermodynamic processes will be altered in conformity to the new statistical situation.

"But that is enough to show the technical possibility of the experiment."

---

*This "early genius," of course, was Clerk Maxwell.

A technical definition of entropy (Evans): "The change of entropy from one state of a system to another is the integral of dH/T from the first state to the second, the integral being taken along a reversible path, with dH representing the element of heat added at the temperature T."

A statistical interpretation of that definition is that every energy change in a system tends to proceed in the direction of maximum probability. That is, in the case of the confined gas, it follows from the conditions of probability that the molecules will tend to reach an average state of equally distributed energy in all parts of the system.

When a piece of red-hot iron is plunged into a bucket of cold water, it is not "impossible"—according to the chemical laws of molecular dynamics alone—that the molecules of iron should continue to absorb energy from the molecules of water, until the water is frozen and the iron fused. That remarkable occurrence would involve, however, a decrease of the entropy of the system. Statistically, it is very improbable, because the energy present can be distributed among the molecules in an immensely greater number of ways when the water and the iron have both reached the same average temperature. And any blacksmith can testify that, actually, it seldom happens!

Crudely conceived, then, entropy is the measure of chaos, confusion, dissipation, of spent and useless energy. As clocks run down and rain falls and coal burns and the sun shines and your car is braked to a stop and your eye reads this page, the entropy of the universe is being increased. All energy runs down a hill, up which, without the aid of something like Maxwell's demon, it can never return.

SERU GYROC paused again. His burning eyes scanned the thousands of his listeners, beneath the golden-starred dome. Ringing eagerly now, his low voice resumed: "And think what success would mean! Freedom from the old limitation of entropy: that energy must always be lost, wasted! Our fuel and power problems solved forever!

"A man could draw heat from a mass of ice to cook his dinner! He could collect energy from the air to run his planes and vehicles—the very same energy that they had dissipated through friction—and travel forever without any cost in fuel!

"Our children—if your courage allows me to perform this experiment—can gather dark waste radiation from the void, and condense it into matter again. They can build themselves new worlds and new shining suns—forever!"

Once again the white-robed scientist waited while tremendous applause reverberated against the green columns.

"That is my plea," he finished quietly. "This thing can be done. I grant that it will be costly; I grant some element of danger. But I am eager for your permission and your aid to do it. It is a grave matter; consider it well. Please listen now to my opponents. Then—the decision is yours!"

He went slowly to his seat.

And Ron Goneen, recognized by the presiding officer, stalked grimly forward. The mighty, red-bearded explorer of space stood for a moment silent on the dais.

"I am sorry that I must oppose this plan of my friend and teacher," his deep voice rolled against the dome. "I am sorry to oppose any brave effort to increase the greatness of man. Perhaps it seems strange that I do. But I have been long away from the sheltered planets of the galaxy, and I have felt the blind, terrific might of the cosmic forces with which Seru proposes to tamper."

Soberly, his deep-set, narrowed blue eyes scanned the multitude.

"I am proud of mankind," he said. "For a hundred thousand years the human race has marched steadily upward. We have conquered all the galaxy. From a 'minor phenomenon of planetary decay,' as one ancient cynic put it, man has become the dominating intelligence of an entire galactic system. He has won a freedom, a power, a longevity, a perfected happiness, that would amaze his less fortunate progenitors."

His great scarred hands knotted earnestly at his sides.

"Are we then to risk all this advance—everything that our race has ever accomplished since the first terrestrial beast rubbed two pieces of wood together and discovered fire? Are we to gamble all that upon one turn of an unknown wheel?

"And for what?"

The deep voice was husky with desperate urgency.

"To prepare against a doom that will not be imminent for a million million years? Isn't that sheer folly?"

His rugged, stern face looked to the white-robed scientist in his seat, and back to the thousands. "Or to gain needless, fantastic powers? What is the need to cook on stoves of ice, or to collect the waste energy of friction, when we have reservoirs of atomic power to last a billion years?"

His voice rumbled deeper. "What is the need to build new worlds, when Andromeda and a million million other island universes lie waiting for the explorer and the pioneer? Is there no room for triumphant adventure, without tampering with the very foundations of the universe?"

His solemn face lifted to the vault of stars. "Since the dawn of terrestrial history, man has struggled through superstition and religion and science to solve this ultimate problem: the riddle of crea-

tion. He has never done so—and it is well that he has not!

"For our own lives are among the phenomena of increasing entropy! Let us not seek to overrun the balance of the universe, and set time itself to flowing backward—lest we perish with our success!"

Ron Goneen stepped a little backward; his voice sank lower.

"That is all I have to say. It should be enough. Think well before you act. For the future of humanity—the very life of the universe—is in your hands."

He sat down abruptly, grim-faced as ever.

THE presiding officer again recognized Seru Gyroc, who resumed the dais to say: "Yes, the life of the universe is indeed in your hands! For, if your decision is against the experiment, I shall destroy my notes.

"And let me say that it was but a singular chance of reasoning that led me to discover the Gyroc Tensors. They are an anomaly in this universe of increasing entropy. No phenomenon guides the mind to them. It is safe to say, on grounds of mathematical probability, that my tensors will not be discovered again in this universe."

His voice was suddenly loud and clear.

"The supreme privilege is yours! To vote for eternal life, for the power of creation itself, for the ultimate victory of mankind—or for retreat, failure, and inevitable, everlasting, changeless death!"

The presiding officer again looked inquiring at Ron Goneen. But the weather-beaten space captain sat rigid and impassive in his chair, with mighty arms folded and narrowed steel-blue eyes staring bleakly ahead, as if at some awesome vision.

Seeing that the president was about to call for the vote, Seru Gyroc rose hastily to make a final plea: "Personally, I believe that the danger of the Omega Experiment has been very much exaggerated. I would not willingly endanger other lives than my own, even in the cause of science.

"And let me assure you that if the council approves the experiment, it will be performed with every precaution for safety. All my fellow workers will be carefully protected. And the actual research will be done at some point far outside the galaxy."

The presiding officer looked again, a little anxiously, at the space captain. But Ron Goneen still sat mute, staring—as if he already perceived the horror of the disaster of which he had spoken warning.

Somewhat reluctantly, the president called for the vote. Each member pressed a button on his desk. Tabulated automatically, the result was instantly flashed on a huge screen at the end of the chamber.

"The Galactic Council," the sonorous and somewhat regretful voice of the official reverberated against the green columns, "has declared its approval of the plan!"

As his voice echoed and died away, a hushed restraint filled the Hall of Worlds, as if the thousands felt a stricken apprehension at what they had done.

Ron Goneen rose quietly in the silence, made his way to Seru Gyroc. He bowed, took the hand of his old master. "You have won," he said. "It is to be. I hope my fears prove to have been without foundation. And let me be the first to volunteer my aid—for, come success or disaster, this will be the greatest adventure of man's history."

Seru Gyroc was trembling, with tears of emotion in his eyes.

"Thank you, Ron," he gasped. "I am glad to have you with me again, and your aid will be priceless. And I hope"—his voice was very grave—"I hope man never regrets this day!"

Suddenly, then, a wild and tremendous wave of cheers broke through the silent Hall of Worlds.

IV.

THAT SAME DAY, the enthusiastic Galactic Council passed the necessary measures to authorize and finance the Gyroc Research Expedition, "Dispatched for the purpose of discovering a method for the controlled decrease of entropy."

And Ron Goneen offered the use of the veteran *Silver Bird*. Stained with the corrosion of many atmospheres, battered with the accidents of two million light years of space, scarred from the attack of the Andromedans, it was still the most powerful existing ship.

In the busy yards of the Galactic Patrol, beneath the red-and-blue binary sun of Melchonor, it was completely refitted, and provisioned with supplies to last the expedition, if need be, for half the fifteen centuries of a normal lifetime.

Vastly elaborate machine shops and laboratories were set up aboard, equipped with many pieces of apparatus designed by Seru Gyroc that were completely new to science.

Ten years had passed when the preparations were complete, and the twelve hundred selected members of the expedition gathered on the dock beside the *Silver Bird*.

Before any came aboard, Seru Gyroc appeared in the entrance valve, looking frail and thin in his severe white robe, yet animated with indomitable purpose.

"One word, before we depart," he said. "You are mostly young men and women. You represent the galaxy's best. You were selected from millions who volunteered. You have much to lose: youth, vigor, genius! Are you prepared for great sacrifice?

"I must tell you that our destination is the tiny, sunless planet of Pyralonne, discovered by the Andromeda expedition. It lies two hundred thousand light years from the limits of the galaxy. We have selected it to minimize the danger of the experiment.

"You must all realize that our research may be fatal to some or all of you. Even otherwise, you must be prepared to spend several centuries upon dark, frozen Pyralonne, toiling in a grim exile of science. There will be no later opportunity to return. Let any who wish now withdraw. The rest will please come aboard."

The twelve hundred pressed eagerly forward, cheering. Ron Goneen strode forward silently from among them. His tanned, rugged face very grim. He strode up the gangway, clasped the thin hand of Seru Gyroc, and entered the vessel without a word. The chosen hundreds followed, marching out of the purple twilight.

The long hull was sealed at last. Ron Goneen, standing beneath the transparent dome of his bridge, gave the order to rise. Gigantic atomic generators fed power to the kappafield coils, and the *Silver Bird* was off!

The red sun and then the blue rose again, as the globe of Melchonor fell behind. They dwindled to tiny disks—to a ruby point and one of sapphire. The two points merged into one, and that was lost in the silver clouds of the galaxy.

YET, swift as was the *Silver Bird*, plunging through millions of miles in a second, drawn into a tiny subspace of her own by the field warp of the kappa coils, seven years had passed before she approached her destination.

Little larger than the ancient Moon of the mother planet, Pyralonne had been flung by some unguessed early cataclysm from the gravitational embrace of its own parent sun.

Adrift among the stars, it had acquired, through millions of years, by the rule of equipartition of energy, the ter-

rific velocity appropriate to its own tiny mass. Until at last, a freakish "runaway" world, it had burst free to go plunging forever into the dark gulf beyond its mother universe.

Overtaking it, the *Silver Bird* slanted down across cragged, barren ranges that had not changed in a million million years, to land upon a plain. Once that bleak plateau may have known the brief flash of life. But since before the birth of Earth it had been sunless, changeless, the silent abode of frigid and eternal night.

Armored against the complete vacuum and cold nearly absolute, men emerged beneath a sky utterly black, sunless, starless. In one quarter was the vague, silvery spindle of the galaxy—visible with light that had left it two thousand centuries before. Opposite was the dim tiny spiral of the Andromeda Galaxy, four times more distant.

Undismayed, however, the explorers set to work at once.

With stone quarried from that bleak plain, using tools and materials from the ship, they at once began erection of the laboratory: a great solitary tower, crowned with an immense flat dome.

The ship itself, connected with the tower through a long tunnel, served as auxiliary workshop and living quarters for most of the expedition.

FOUR MORE YEARS had passed before the actual research could be begun, with Ron Goneen in command of personnel and Seru Gyroc in charge of the laboratory.

Already many members of the party, oppressed by the weight of cold and darkness, and recalling Ron Goneen's dire predictions, were beginning to regret their early courage.

For, as the slender scientist had foreseen, the conquest of the Omega Effect proved a long and arduous task. As the years grew into decades, Seru Gyroc himself sometimes admitted discouragement.

Even on Pyralonne, however, existence was not absolutely cheerless. Sometimes, under favorable conditions, the hyperchron beam brought news from home; and the great ship provided facilities for rest and recreation.

The expedition included a few hardy and daring women. Among the most brilliant and the most beautiful of them was tall, regal Karanora Quane, who had been for many years Seru Gyroc's assistant in his biological research.

The members of the expedition spared little time for love, and few cared to bring forth children who would know only this grim world. But Seru Gyroc and his lovely assistant were married before the first century had passed, and a daughter was presently born to them.

The child was named Lethara. Many were grateful for her golden-haired presence among them, for the difficulties of the research had begun to seem insuperable. The smiles, the laughter and the songs of Lethara enlivened many weary decades.

Discontent grew bitter, as the second century slipped away, until a company of mutineers attempted to seize the *Silver Bird*. They blocked the tunnel leading to the laboratory tower, and welded the bulkhead doors upon those aboard who refused to join them.

Ron Goneen, however, was on the bridge. He held it, single-handed, for twenty hours, until Lethara, now a grown and beautiful woman, came in a space suit from the tower to tell the mutineers that her father had made a hopeful new discovery. She joined Ron Goneen, and together they induced the rebels to surrender.

MORE YEARS PASSED, however, and the second century had turned before the supreme day of the actual experiment. The tower had been carefully insulated against the Omega Radi-

lation, and the apparatus was set up under the dome. Ron Goneen and Seru Gyroc alone remained with it, sending all the rest aboard the ship.

Karanora Quane, and her lovely daughter were the last to leave the tower.

And tears glistened suddenly in the steel-blue eyes of Ron Goneen, speaking to Lethara—in the eyes of Captain General Goneen, who had stalked a thousand planets and two galaxies, with never a second glance at any woman!

Lethara clung to his bronzed form suddenly, her violet eyes dark and big.

"There is danger, Ron?" she cried. "So much danger?"

"So I said, two hundred years ago," said Ron Goneen. "And so I still believe."

"Then why—why do you go on?" she demanded. "When there is so much to live for in the world that is! I wish so much to see the things I have never seen—sunshine and blue skies and green things growing, everything back there!"

"I wish, Lethara," Ron Goneen said softly, "that I could show you all the worlds that I have seen. Lethara——"

Softly, she whispered, "What is it, Ron?"

"Lethara," he said again, "if I am alive after this experiment is done, I shall have something to tell you. But now you must go!"

Her eyes were suddenly wide and deep with dread. She clung to the great arms that pushed her away.

"Alive—— Oh, Ron!" she gasped. "Do you mean——"

Her father took her arm, drew her toward her queenly mother.

"Don't be alarmed, my dear," he urged her. "We have taken every precaution. The only risk is the unforeseen——"

The girl's frightened eyes looked away from him, back to the rugged, bronzed face of Ron Goneen, grim again with his forebodings.

"Smile, Ron!" she begged him. "And promise you will live—to tell me that!"

The rugged, weather-beaten features of the space captain creased into a slow, stiff smile, even while sudden unwanted tears shone in his deep-set eyes. His voice came, at the second effort, a deep hoarse croaking, "I promise—Lethara that——"

And she was gone.

Having locked and sealed the turned door, Seru Gyroc turned to cry exultantly, "Now we conquer entropy!"

V.

ALONE in the tower, the two men climbed back to the floor beneath the dome, where the apparatus had been erected. In the center of the room was a small metal pier. Bearing upon it, arranged in an ominous-looking circle, were the gigantic barrels of the seven ray projectors whose interfering frequencies were expected to generate the Omega Radiation.

With thin fingers trembling a little, Seru Gyroc set a glass beaker of water on the pier. From a glass rod across its top he suspended a little globe of silver, so that it hung in the water.

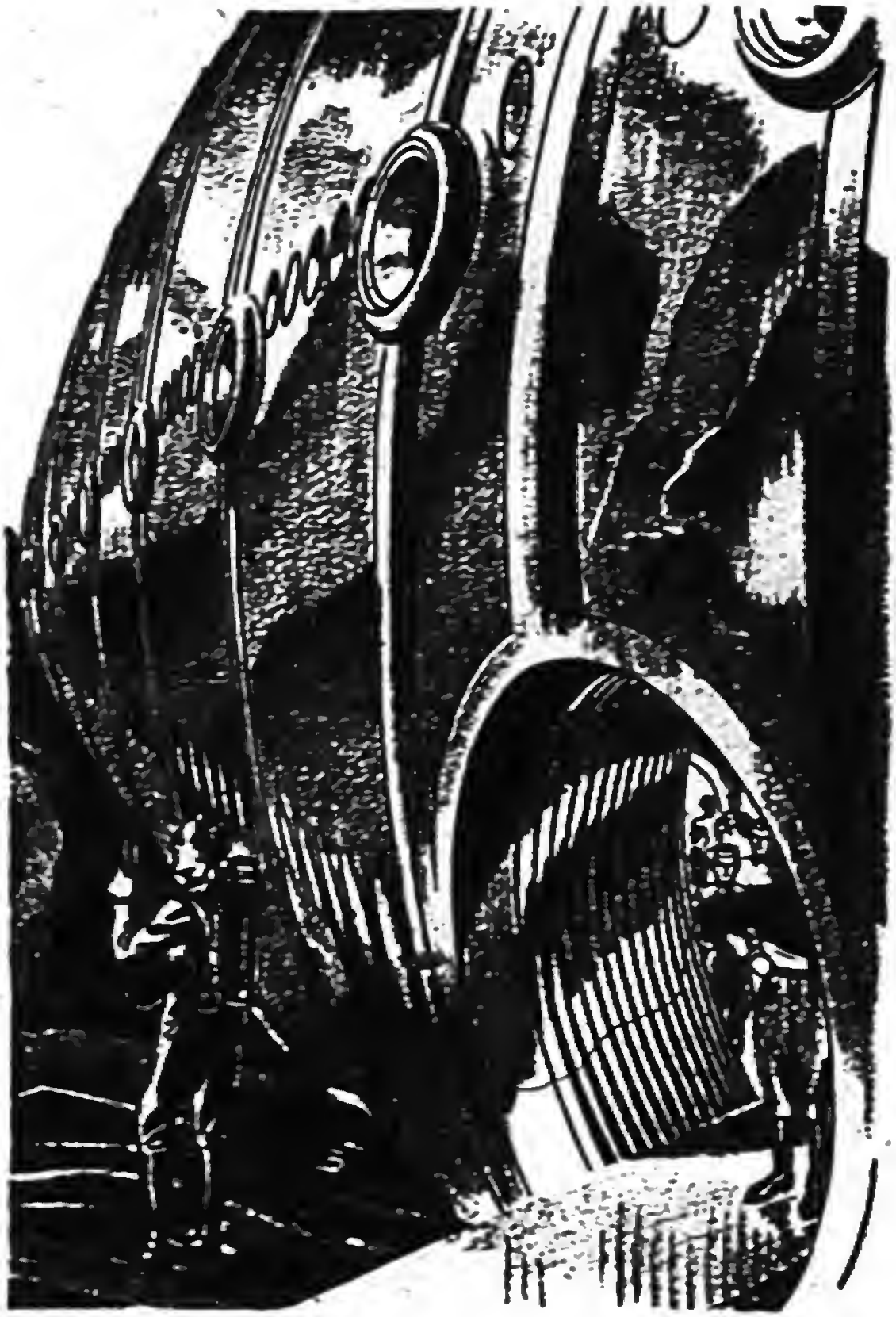
One by one, he began to focus the great barrels upon the tiny argent button——

Ron Goneen had gone to one of the little armored ports. He shaded his eyes from the light within, looked out across the frigid, dark plateau. In the distance, beneath the slanted, silvery disk of the galaxy, he could see the red-and-green beacons at the landing field, and the flying lights of the *Silver Bird*.

The latter rose, as he watched, like colored stars in the black sky, diminished, then vanished at last above a bleak mountain range. The ship was gone, with Lethara—— He closed the insulating shutters.

"We'll give them two hours," he told Seru Gyroc. "I ordered them to stand

He was speaking into a microphone. And before him, floating in a many-colored, luminous mist was a monstrous nine-pointed star.



off ten billion miles, in case of any—accident——"

He stood bleak-faced, watching, as Seru Gyroc finished his last fussy adjustments, and stepped back at last to look with a nervous impatience at the tiny silver bead suspended in the water.

"It's ready." Gyroc sighed. "The heterodyning beams should set up the Omega Effect in the silver ball. The normal conditions of energy probabilities should be reversed. The silver should absorb heat and freeze the water to ice.

"I'm going to close the key!"

"Wait," said Ron Goneen. "The two hours——"

The little man looked at him sharply.

"You aren't still afraid, Ron—of so small a thing?"

"It's big enough," the space captain said solemnly, "to threaten the equilibrium of the universe! I had meant to say nothing more, Seru; but, saying good-by to Lethara, I suddenly saw all the glory of life. It is far too wonderful to put into jeopardy——"

HIS GREAT HAND caught the shoulder of the scientist.

"Seru, I beg you," he said urgently, "for the sake of our old friendship, for the love of Karanora, for the youth and happiness of your daughter—give up this thing! Even now!

"We are risking so much—so needlessly! Let us simply destroy the apparatus, and report that the experiment failed!"

"No!" The hard power of Seru Gyroc's voice was suddenly like the vibration of a great dynamo. "We shall not turn back. If you are afraid, captain, you should have gone with your ship."

"It is not for myself," said Ron Goneen, "but for the others, for the universe, for Lethara! I beg you——"

The dark eyes of the scientist flashed to a chronometer. "The two hours have gone, Ron," he said quietly. "We begin! Stand by the safety controls, if you like——"

The tall space captain stepped suddenly forward, his great hands grasped abruptly for the other's shoulder.

"I am sorry to do this, Seru," his deep voice began, "after you have worked so long. But I am going to stop you! The risk is too great——"

With a surprising agility, however, the black-haired little scientist stepped swiftly back. A thin hand flashed into his white mantle, came out with the deadly little pointed rod of a positron gun.

"No, you won't stop me, Ron!" His dark eyes were flaming, his narrow face wild with a fanatic elation. "Mankind must perish, in the end, or rule the tide of entropy. And to-day—by myself—is the issue decided!"

"Stop!" gasped Ron Goneen. "You are mad——"

"Stand back!" the cold voice rasped. "Or I shall report that you perished in the experiment——"

"Go ahead," boomed Ron Goneen. "That would be your smallest crime. For, you are about to murder mankind—about to wreck the very universe!"

His narrowed eyes fell to the tiny, bright needle in Seru Gyroc's unwavering hand. He knew that its beam of pure positive electric flame could sear and destroy a human body in an instant. For some distracting ruse——

His long, tanned body suddenly tense, he peered at a tiny port above Seru's head. "A ship!" he cried. "It must be the *Silver Bird*, returned—and it is ramming the tower! I knew they would find a way! Look out!"

The bleak eyes flickered briefly aside, as he leaped. But they came back to him, cold and dark as the sky of Pyralonne, flaming with a mad determination, merciless.

At that moment, for the merest ter-

rible instant—and the thing was to become a fantastic enigma, to haunt all his latter life with its mad dilemma—he thought that the ramming ship was no ruse. A cold, silvery projectile indeed was smashing into the tower!

But golden fire, jetting from the cruel, steady needle, struck him with an avalanche of agony. That brief insane impression was burned away. In a last frantic effort to reach Seru, he lurched forward against the merciless flame, crumpled——

VI.

RON GONEEN was swimming through a void of terrible darkness. Far ahead of him, somewhere, were flickering gleams that seemed to mean warmth, life itself. Swimming, walking, flying, crawling, he struggled always toward them. But they fled away, like mirages. A cold cloud of darkness followed after him, implacable in its alien sentience. At last, however, pursuing one gleam of mocking flame, he came up to it. He thrust his stiff arms about it, tried to warm himself. But the flame turned black before him. And somehow it drained the warmth from his body, so that he was fearfully cold.

Still, he somehow knew, the black flame was hot. But its heat was selfish, useless. It radiated no warm rays, but seared him instead with bitter cold and then danced away like a malicious, mocking being.

He groped toward another. But the pursuing darkness was becoming thicker; it began to press upon him like some heavy, viscid liquid. The numbing ache probed deeper into his bones. He was freezing. The flame was there before him, but it gave no warmth.

The big space captain woke, then. He was lying, shivering, on the floor of the laboratory. His left shoulder was blistered. The cloth of his green tunic was still smoldering around the edges of a small hole, where the positron ray had struck.

But what was this cold in his bones?

A shadow passed over his face. He opened his eyes, sat up with a painful effort. Then he saw Seru Gyroc—and he shuddered to a cold shock of bewildered dread, as painful as the ray!

This was no longer the confident, black-haired, still-vigorous experimenter. It was an old, old man!

For Seru Gyroc was stooped and shrunken. His pale hands trembled weakly. His white face was a lax, shriveled mask, deep-lined with some unutterable horror. His dark eyes, strangely hollowed and sunken and glazed, were the eyes of one who has looked into a forbidden, searing hell. And his long hair, so dark before, was now completely white.

His quivering hands tried vainly to help the injured man to stand.

"I'm sorry, Ron—so terribly sorry!" His gasping voice was thin, quavering, cracked. It was the voice of an old, a fearful, a shattered man. "I have been utterly, criminally wrong! Please—oh, please try to forgive me! I shot you down in utter madness!" And the dreadfully aged man dropped on his knees, sobbing.

THE SPACE CAPTAIN got stiffly and slowly to his feet, drew the haggard scientist up beside him. He looked fearfully at his own huge, scarred hands, saw with relief that they looked as young and powerful as ever.

"No, you escaped the main force of it," that broken quaver assured him. "You were lying behind the shields, and I think the positron shock partially immunized you."

"What happened?"

Bewilderedly, Ron's blue eyes swept the broken, twisted apparatus about the shattered metal pier. There was no trace of the silver head or the beaker of water in which it had been suspended.

Still sobbing, the experimenter so strangely shattered and old was peering mutely, blankly, at his broken apparatus.

"The experiment!" urged Ron Goneen. "Did you try it?"

"I did," said that aged voice. "I finally got the projectors synchronized to generate the Omega Radiation in the silver ball. I stood here, watching——"

"And what happened?"

"At first," gasped the old man, "I thought it was successful. The ball turned black, as radiation and reflection ceased. The thermometer showed that the temperature of the water was falling, as its heat was absorbed."

His tangled white head shook sadly.

"Yes, for a moment I thought I had won the power of that old investigator's *demon*. I could make heat flow from the cold water into the hot globe, and refuse to let it return! But then——" His voice stopped, with a shudder of his emaciated frame.

"Then?"

"Then I felt it!" whispered Seru Gyroc. "The black globe became suddenly a cold and deadly eye. I felt the chill of it all through me—a horrible cold something, the deadly enemy of life itself!

"I was suddenly stricken, numb, all but helpless. Sweat of horror was on my face, and I felt suddenly that it would freeze—that that horrible globe was sucking the heat out of everything in the room. And then, Ron——"

THE THIN MAN flung himself against the space captain's shoulder, sobbing bitterly.

"Then I did it! I don't know why. I didn't know what I was doing. The globe had begun to shrink. Normally, it should have become larger, expanded with heat. But it was contracting—the utter reversal of nature!

"And still it was like an eye—a dead-black, hypnotic eye! There was life in it. Not the human sort of life, nor the sort we have found on any planet—but an alien, hostile other life.

"And that other life commanded me!

"I was trying to reach the switch. The thing that I did seemed as vague as a dream. I hardly knew that I had done it. The water in the beaker was now frozen to ice. Thick, white frost was crusting over the glass. The room was misty with particles of congealing ice. My fingers were so numb that I could hardly feel the key.

"But at last, with a frightful effort—still fighting the terrible pressure of that eye—I shut off the projectors. There was an explosion, a flash of blinding flame. The apparatus was smashed, as you see it. I was knocked senseless."

"An explosion, I see," said Ron Goneen. "But how?"

"The silver must have reached a temperature of many thousands of degrees," explained Seru. "It had drawn heat out of the water, out of all the room—out of our bodies, even. That concentrated energy was suddenly released, as the thermodynamic interchange resumed the direction of increasing entropy——"

Eagerly, then Ron Goneen seized his arm, shook him. "So it's all over?" Ron cried. "Finished? And no harm done, except the smashed equipment, and——" The voice stuck in his throat, as he looked at the bleached and shriveled form of the little scientist.

"I know that I am changed," whispered Seru. "I saw my reflection on the instruments."

"But you stopped it?" Ron Goneen went. "And the *Silver Bird* will be coming back! And we can take Lethara back, to see all the worlds at home——"

His voice choked again, at the increasing horror that glazed the sunken eyes of Seru Gyroc.

"What's the matter?" he gasped. "Didn't it—stop?"

The dreadful hollow eyes of the shattered man flickered toward a port. And Ron Goneen saw with a start of horror

that the inner, insulating shutter had been slid aside, leaving only the transparent window.

The old man shook his strangely white head.

"That is what I did," he mumbled. "I opened the shutter—because that other life commanded it! I hardly remember doing it. Honestly, Ron—I was helpless, hypnotized! That strange, dead-black, freezing eye——"

Quivering to a cold shock, Ron Goneen opened his mouth and tried in vain to speak. His nerveless hand closed weakly on Seru's thin shoulder.

"No, Ron, it didn't stop," the old man quavered at last. "At first I didn't understand. But I think I see it now. When I broke the circuit, the accumulated Omega force poured out through that open shutter. It must have gone out in a spherical wave—its velocity almost infinite!"

Ron Goneen swallowed, wet his dry lips. "Then what—what will happen?"

Seru's dreadful eyes went back to the port. "Look outside!" he gasped.

VII.

WALKING UNSTEADILY to the unshuttered port, the big space captain peered apprehensively out—upon a thing madder than his dream of horror.

The stark, immemorial mountains of Pyralonne were no longer utterly black. An eldritch, bluish radiation flickered about every jagged summit. And across the lifeless, frozen plains swept fantastic shapes like the phantoms of his dream—like the wraiths of black flame that had seared him with their cold.

He shuddered; their dread cold pierced him, even in the insulated tower.

"Do you see them?" the hollow, sepulchral voice of Seru Gyroc, behind him, was demanding. "The creatures of destruction, born already! The hordes of doom—cold spawn of the Omega Radiation!

"Can you feel their eyes of darkness, staring through your body—like the eye that commanded me? Can you feel their fingers reaching to destroy us? Fingers of cold flame!"

"Yes," Ron Goneen whispered hoarsely. "Yes, I feel them. But what are they?"

"They are life—the new life!" spoke the hollow voice behind him. "With your warning, I should have foreseen—had I not been blind with egotism!

"For our kind of life is a phenomenon of entropy increase. These beings are an alien part of the opposite process. We have set energy to flowing up the hall—and they were born to ride the current! They suck up radiation, simple atoms, all forms of energy. They exist through integration: the building of complex atoms.

"They are vampires! They take; they give nothing. They are actually vortices of intense heat. But they only absorb; they radiate nothing, so that they seem black and cold to us. They drink up the precious force of life itself——"

"Look!" cut in the deep voice of Ron Goneen. "There's a ship—a strange, battered ship!"

His horror-widened eyes followed it, dropping out of the black sky athwart the weirdly blue-crowned crags of Pyralonne. Its hull was rusty, corroded, scarred as if by ten thousand meteoric collisions.

And it brought a disturbing memory.

"Queer!" he muttered. "But I thought—in the last instant before you shot—I thought there was a real ship ramming the tower!"

"And you fooled me!" the old man admitted. "For just an instant of helpless panic." And, bitterly, he added, "I wish something *had* struck us, to stop my madness——"

"But—*there!*" Ron Goneen's nar-

rowed eyes were still upon the ancient space cruiser approaching. "It's out of control!" he gasped. "Falling——"

THE VESSEL sagged drunkenly. It veered unexpectedly toward the tower, so that Ron Goneen caught his breath for fear that singular feeling should prove to have been a premonition. But its mighty prow crashed against the weirdly gleaming plateau, two miles away. It rolled half over, very deliberately, and lay still.

Ron Goneen's breath went out in a long gasp of pain. "That—that's the *Silver Bird!*" he breathed hoarsely. "But look at it—battered as if it had been drifting ten thousand years. And it left here, three hours ago, shining like new!"

Behind him, the hollow voice croaked, "I have done this, also! For time has gone mad, along with entropy—because the one is the child of the other."

Still watching from the port, Ron Goneen's rugged face was grim and drawn with horror. For a valve of the fallen ship had opened. His eye caught the motion of tiny figures.

Could one of them be—his heart leaped with hope and fear—Lethara?

He groped for a pair of binoculars hanging beside the port, lifted them. The harsh landscape seemed to leap at him: naked, black rocks, every jagged point limned with pale-blue fire.

It was as if some electrical energy were being drawn out of the planet, he briefly thought, and sucked away into space.

He found the running figures. They were only a score in number—of the great ship's twelve hundred. Their leaping bodies were bulky in the space armor, heads visible in egg-shaped, transparent helmets. Every face was haggard, drawn, horror-twisted.

They were fleeing across that weirdly shining desert. And behind them, pursuing, came the shapes he had seen—the phantoms of black, freezing flame.

He saw one straggler fall behind. The spinning phantoms overtook him—or her, for Ron had failed to see. The figure stiffened, fell. Blue flame played briefly over it. It left the rocks, lifted into a whirling column of darkness. It was gone—consumed——

"The other life devours them," said the hollow voice of Seru Gyroc. "It absorbs their heat, consumes their lives, integrates their atoms——"

Ron Goneen was suddenly rigid with hope and horror. For his staring eyes had found one familiar face, and then another—familiar still, although terrible with agonized dread.

"Lethara!" he gasped. "I see Lethara and her mother!"

The taller form of Karanora seemed weak, stumbling. The girl was aiding her. They were falling to the rear of the fugitive group.

Ron Goneen dropped the binoculars, ran toward the stair.

The lean, quivering fingers of Seru Gyroc clutched his tunic. "Wait!" the old voice quavered. "What are you doing?"

"I'm going to help them," gasped Ron Goneen. "Let me go. Lethara needs me!"

The thin fingers closed hard on his arm. "You can't live outside," warned Seru. "Your body heat will draw the other life——"

"I must," said Ron Goneen. "For Lethara——"

He broke free, stumbled down the steps toward the air lock. Swiftly, he flung himself into a suit of insulated pressure armor, slipped the transparent helmet over his head, let himself out of the valve into an explosive puff of freezing air.

THE dark, rocky waste stretched before him, every ragged point still shining with eerie and ominous blue. Far

in the distance he saw the little group, each frantic figure outlined in a terrible aura.

He came shuddering against a strange wall of cold. Despite the insulation of the suit, he felt as if chilling fingers had reached through to probe his body.

This was the same piercing cold he felt in the dream.

Fighting it, he ran toward the distant group. They still fled before the black phantoms. One and another, as he watched, stiffened and fell—and the things swept down upon them, lifted and consumed their bodies.

Not half the original score were left when he plunged into a depression that was a vale of shining horror, a cup of cold, blue dread.

Panting, breathless, sweat-drenched and yet shivering, he mounted the burning slope beyond. Cold fear smote him. Only three of the fugitives were left. And one of them, as he looked, grew stiff and fell.

For a moment it lay still, the core of a blue shimmer. Then a tentacle of spinning blackness touched it: it whirled upward like a leaf in the wind: it was gone.

Ron Goneen stumbled onward, toward the two.

They saw him. One of them beckoned in wild appeal for aid. The other made a frantic gesture as if to warn him to go back.

Then he could see their faces, through the blue glow surrounding their helmets. They were Karanora and Lethara. The girl was still aiding her mother. It was she who had beckoned him back.

The mother suddenly stiffened, as the others had done, and fell. With another frantic, warning gesture at Ron Goneen, the girl bent over her, tried in vain to lift her.

Staggering, his body stiff and leaden with penetrating cold, Ron Goneen came up to them. The once lovely form of Karanora Quane lay stiff upon the shining rocks. Her face was already blue and lifeless, a frozen mask of horror unutterable.

Anxiously, the younger woman touched the arm of his suit. "Oh, Ron!" she cried. "My mother! Help my mother!" Her own face was pinched and white with cold, her violet eyes wide and strange with uncomprehending dread.

"It's too late," Ron Goneen gasped into the tiny microphone before his half-frozen lips. "Karanora is dead—and there's just the barest chance for us! Come——"

But she tried with her feeble strength to push him away. "Then go back," she begged. "Save yourself, Ron! I'm too weak to go any farther—too cold!"

He held her unwilling arm, pulled her toward the tower at a stumbling run.

BUT his stiff body ran like an ill-oiled machine. Every step took an age of effort. He ached with fatigue, with the queer, numbing pain of this penetrating cold. The blue flame was denser about him.

He fastened his dimming eyes upon the black tower. Squat and immense, it seemed an infinite distance across the shining waste.

"Go on, Ron," the girl was sobbing. "Leave me. It was brave of you to come. But it was no use. Death is in me, already. The black, freezing flames—— They sucked out *something*. Leave me, Ron. Just remember that—I loved you!"

Her hand went rigid in the insulated glove. She fell.

Ron Goneen bent, picked her up in his great, numb arms and ran on. All his body was dead now. It seemed that it was not he who moved, but some lifeless machine—that he merely watched.

The machine stumbled and fell. It picked itself up, lifted the girl, staggered on.

Behind came whirling black pillars of

darkness; vampires hungry for the little heat left in the machine, for the atoms that formed it.

Again the machine toppled forward. This time it could not rise. It pushed stiffly forward on hands and knees, dragging the stiffened body of the girl.

The black base of the tower was near, the square entrance of the air lock outlined with glowing blue. Warmth! And a haven from the destroying phantoms!

Struggling grimly for mastery of the dead machine, Ron Goneen felt suddenly the tiny pressure of a little round object, under his tunic—the singular bubble of light that he called the Jewel of Dawn: the luminescent holy stone of the Andromedans, that he had taken for a torch, had carried since as a badge of triumph. No, carrying the jewel, he couldn't give up!

The leaden limbs moved stiffly. The machine inched forward, dragging the girl. And at last they were inside the black, square chamber. Darkness came again, as his fingers closed over the control wheel.

VIII.

WHEN Ron Goneen awoke—or came slowly back to a drugged half wakeness—he lay in the dark cubical space of the air lock. And Lethara was still inert beside him, very quiet in her bulky armor.

The inner valve had been opened, however. The air about them was not bitterly cold. And their transparent helmets had been removed so that they could breathe it.

Wondering how long he had lain unconscious, the space captain sat up painfully. His big body was still cold and stiff, and a leaden depression filled his mind. He shook his shaggy head, tried to rouse Lethara.

The girl would not completely wake, however, although she stirred uneasily and called his name in a low, half-eager, half-anguished tone.

He got awkwardly out of his own space armor, removed hers, and carried her in his arms up to the living quarters on the second floor of the tower. Still she slept, as he laid her in a bunk. Her oval face looked thin and pale.

He returned to pull the covers up about her shoulders, touched her pale-golden hair, and then hurried away to find her father, his bewildered mind full of this dread enigma.

Seru Gyroc was wearily pacing the wrecked laboratory above, running shivering fingers through his strangely bleached hair. His shriveled, haggard face, his glazed and sunken eyes, made a living mask of horror and despair. He started nervously.

"Ron, this is you?"

"It is!" The deep voice tried to sound cheerful. "I carried in Lethara. She is sleeping. I think she's all right. But Karanora——" Ron spoke gently. "I couldn't help her."

The white head shook wearily.

"It makes no difference, about anybody," whispered Seru. "Doesn't matter—dead or alive——"

"But it does matter!" boomed Ron Goneen. "We'll keep alive—somehow. We've got to keep *her* alive. The ship is wrecked, of course. But there's a life tube here in the tower. We'll manage to get back to the galaxy. We can do it—*somehow!*"

A ghastly, stricken figure, Seru Gyroc came unsteadily to stand in front of him and peer into his face with terrible hollow eyes.

"Don't you realize, Ron? When I opened that shutter and stopped the apparatus, I turned something out—something that hasn't stopped."

Ron Goneen gripped Gyroc's thin shoulder with huge, anxious fingers. "There's no way to stop it?"

"None. The Omega Ray went out faster than light! Faster than time—because it destroyed the meaning of

time!" The white head shook. "There is nothing we can do, although the insulation of the tower will probably preserve our lives for a while—a little while."

Ron Goneen searched his terrible face.

"How far will it go?"

"To the bounds of the universe—growing ever stronger! Because, like the force of cosmical repulsion, its effect varies directly with distance."

Ron Goneen dropped his big hand and staggered back. "Then all," he whispered, "all the galaxy—all humanity is——"

Great tears shone in the hollow eyes of Seru Gyroc. "All humanity," his dry voice rasped, "all our cities, all our planets——" His silver head bowed. "What happened to the *Silver Bird* and those aboard has happened everywhere——"

"Has happened?" gasped the space captain.

The stricken scientist nodded. "Sooner, probably, in the most distant galaxies than in our own," he whispered. "Probably"—he swallowed with an effort, and went on in a dry, leaden tone—"there is not a human being left alive, save us in this tower!"

Trembling, his thin hand pointed at an unshuttered port.

"Look!" he quavered. "Look at the sky! You can see—already——"

RON GONEEN swayed to the tiny port, put his face to its heavy lens. Against the darkness above a ragged wall of blue-crowned summits, he could see the galaxy, a long spindle of silver spanning many degrees.

But it had changed! It was changing, incredibly, as he looked! The spinning rotation of its spiral arms was visible. In a second he saw the normal motion of a thousand centuries! And it was reversed, turning backward!

"What is it?" he gasped breathlessly. "What is happening?"

That terrible voice behind him croaked again, "Look at Andromeda! Look at the rest! Our galaxy, being nearest, was the last to change——"

Ron Goneen staggered across the wrecked laboratory, pushed aside the shutter from another port. He saw that the Andromeda Galaxy was also visible in its motion, and turning backward.

And it was shrunken!

The spiral arms were drawing in. And its silvery glow had darkened to an eerie, bluish hue, like the luminescence that covered the frozen rocks of this stark world.

"Beyond!" quavered Seru Gyroc. "The rest!"

He thrust a pair of powerful binoculars into Ron's stiff hands. Peering through them into the dark chasm of the empty sky, the space captain saw myriads of spinning, bluish motes, all rushing toward him, all shrinking and growing dark as they came.

"What is it, Seru?" he demanded again. "I knew that there was some danger—but I can hardly understand why——"

"Space itself is contracting," echoed that doomed voice. "All stellar and galactic motions have been reversed. The nebulæ are contracting in the direction of their original condensations. Their radiation is being drawn back, absorbed, reintegrated into heavy atoms."

"But how can we see it?" Ron Goneen demanded. "This light by which we see them was emanated a million or a hundred million years before the experiment was begun!"

The scientist shook his haggard white head.

"Time and the words 'before' and 'after' no longer have a meaning—except for events that take place in this insulated tower. For time is only our

consciousness of the continual increase of entropy, a measure of the running down of the universe. And entropy—except in here—is nowhere increasing."

Ron Goneen stared out again. The blue glow, he thought, was fading from the rocks; the blue, spinning motes of doomed galaxies were fainter in the sky.

"It will soon be dark," Ron whispered hoarsely. "Everything—gone ——" He closed the shutter upon the mind-staggering doom without. Swaying heavily, like a man dead drunk, he stared at Seru Gyroc. His hoarse voice asked faintly, "And what will be—the end?"

THE stricken scientist had resumed his weary, aimless pacing. His thin, quavering reply came in disjointed fragments. "We set the current of entropy to flowing backward. No stopping it——" The universe is winding up again. All matter will be condensed again into a single superatom. Even this in the tower, after the insulation fails. Our bodies——

"No energy is ever created, ever destroyed. But we have undone all the work of time. Perhaps, eventually, the balance will be turned again—although not, I think, without the intervention of intelligence. The other life may do it——

"And the superatom will disintegrate again—disperse its matter through a space once more expanding, in galaxies, suns, planets. The river of entropy will flow down the hill again——"

Ron Goneen lurched forward protestingly.

"So men many be born again!" he muttered bitterly. "If the word 'again' has any meaning when time has been destroyed! He may again conquer the galaxy, and again attempt to master entropy, and again destroy himself and——"

His narrowed blue eyes, savage and brooding, stared at Seru Gyroc. "Tell me, my old teacher!" he demanded hoarsely. "Is that cycle of birth and struggle and doom, of birth and struggle and doom, of winding up and running down, of eternal, senseless repetition—is that less horrible than the single, inevitable death that might not have come for a billion billion years?"

The thin man stopped his restless pacing, bowed his bleached head. "It is more horrible," he whispered. "It is infinitely more horrible. You were right, Ron, from the beginning. And I was a fool, an insane egomaniac. Your words were the truth. I have murdered mankind!"

His stricken voice sank. "I have murdered the universe!"

TO BE CONCLUDED.

SPECIALIZATION

by R. R. Winterbotham

"Something beyond the power of imagination—man as he will be a million years in the future!"

A STRANGE regard was in the woman's eyes. It was admiration, undoubtedly, for Ted Riker was young, handsome and quick-witted. But the glance was not all that which a young woman bestows upon an interesting young man who is a guest in her father's home. It was something akin to pity.

Nor was Riker intrigued by Kathryn Von Shuler. She was as ruthless in her manner as a hidden reef, just as hard in her analytical composure and in that note of pity in her glance was a hint of danger.

"Your father said nothing about you in his invitation to visit his laboratory," said Riker, politely. "It is a surprise to

learn he has a daughter."

"An agreeable one, I hope?" She smiled. "More agreeable than the general surroundings, at least?"

Riker nodded. "It is rather weird here, with all these stuffed animals and fossils."

She nodded. "We're isolated from town. There are no near neighbors. Father prefers that we live in this way. His experiments are never understood by laymen."

"Yes," agreed Riker. Karl Von Shuler's reputation as a choleric biologist would explain, perhaps, why the scientist was always at odds with every one but himself.

The young woman led Riker into a large room, apparently the ballroom of the old house. Now it was transformed.

"Father will be ready to meet you in a few moments," she explained. "Perhaps you'd like to look around?"

"It's a regular museum!" gasped Riker.

"It is quite an extensive collection of specialized vertebrate types," said the young woman modestly. "Father's a bigwig in the field, you know. But then, you're one, too!"

"My specialty is reptiles. I'm working on an antidote for snake and gila poisons."

"Father goes into all lines—birds, for instance, living and dead. He's proud of that ten-foot fossil moa, his dodo skeleton and other rarities. He prefers spectacular types."

"Birds in the bush, eh? I like mystery, too."

"Personally, I prefer mammals to birds," she went on. "They're more intelligent—closer to the ultimate perfection. Father has some dissectual studies here of the aard-vark. See? That case. He's appended a diagramatic study of the construction of its muzzle and tubular mouth. He's always off the beaten track. Look—koalas, wombats and marsupialia moles from Australia!"

"And not a single garter snake from Indiana?"

"No. But if you're so interested in reptiles, here's a *sphenodon* from New Zealand. It's the only reptile of its order extant and it's nearly extinct. It has a third eye. See the diagram. The eye is an invertebrate heirloom, resembling the invertebrate eye more than the paired eyes of chordates. In men, what's left of the eye forms the pineal gland and causes migrane headaches."

Miss Von Shuler led the visitor to a section displaying types of extinct, primitive Ungulata.

"It's a Noah's ark of freaks," exclaimed Riker involuntarily. "It's a scientific hodge-podge of side-tracked life!" He gazed, fascinated, at the downwardly directed tusks of a fossil *dinotherium giganteum*. "His collection is focused on the blind alleys life has traveled in its course toward—did you say 'ultimate perfection'?"

"If you think man is perfection, get the idea out of your head!"

It was almost an ominous voice that echoed in the hall. Ted whirled, startled. In an aisle between near-by specimen cases stood a figure, slender to the point of skinniness, hump-shouldered and shrouded in a black laboratory gown, which halted short of his knees. The man had something of a ludicrous appearance. He was not more than forty, but a beard, accentuating his slim face, made him look older, the grandfather rather than the father of the eighteen-year-old girl standing by Riker. The man could be only one person—Dr. Von Shuler.

"Mr. Riker, I believe?" He smiled sourly and extended his hand. "I'm glad you came."

Ted took the hand. It was soft, clammy.

"My education would not be complete without viewing your collection, doctor," said Riker. "You see, I, like you, am interested in specialization. I

study the most specialized of the vertebrates: reptiles. I've often wondered why nature specializes so frequently and why her specialists die. I've read several of your monographs and I believed an exchange of ideas on the subject would be mutually profitable."

Dr. Von Shuler waved his hand deprecatingly. "It is only an apparent mystery—a real one no longer. Mr. Riker, I *know* the reason for specialization. That is why I accepted your suggestion for an exchange of ideas. That is why I invited you here. I want you to see ten thousand centuries of evolution completed in thirty minutes!"

THE SCIENTIST led the couple through a side door. It was apparent that Dr. Von Shuler's collection did not end in the large room, nor was his assemblage of bizarre animal life all in glass cases. They walked through a glass inclosure. On each side was a garden, teeming with specialized forms.

Alligators and crocodiles basked near shallow pools. Storks and pelicans waded in search of fish. At the far end was a building from which eerie cries of animals reached the ears of the group.

"My zoo." Dr. Von Shuler smiled. "It is one of the most extensive private animal collections in the world."

They entered.

"I overheard your remarks to Kathryn," continued the scientist. "You referred to 'the blind alleys of life.' I was amused. Once I thought that nature never made the same mistake twice. But I was mistaken. Nature often repeats her mistakes.

"The kangaroo, for instance, supports itself like the Iguanodon, one of the better-known genera of dinosaurs. We have flying fish, flying lizards, flying mammals and birds. Even man flies in an airplane. The Triceratops looked something like a rhinoceros.

"We may expect similarities in closely related species. There are lizards that can be distinguished from a snake only by close examination. The glass snake, for instance, which disjoints its tail to escape an enemy, is really a lizard. But in vastly separated branches of the animal kingdom similarities are still found. There are millions of years between the *Draco volans*, a flying lizard, and the bird or bat or the insect. The bat and the bird are equally unrelated. The worm, the eel and the snake look alike, yet are not the same. The whale and the general run of fishes look like cousins; but even a schoolboy knows that a whale is a mammal."

Ted Riker wrinkled his brow. "There are similarities, of course, doctor. But a biologist can easily point out vast differences in structure."

"I am merely calling attention to certain trends in specialization. The trends are so definite and so recognizable that I dare say on other planets one may find the same general types of animal life that exist here on earth." Dr. Von Shuler led the two into a sun room, inclosed with quartz glass. Scores of monkeys were in glass cages.

Dr. Von Shuler paused before a cage filled with scampering lemurs. "These are *prosimii*," he explained, "the earliest type of primate. Note the flat nails on all digits of both feet, excepting the second of the hind feet, which are equipped with claws. Biologists contend that a general form of life progressed through this stage. It grew upward, developing along the lines of *anthropoidea*, *hapalidae*, *cebidae*, and so on to man. At various intervals forms were left behind, specialized stragglers such as aboral apes, marmosets, squirrel monkeys, baboons, gorillas. These forms are footprints in the sands of evolution. The original general type may have been different, but undoubtedly these forms sprang from that type as it progressed toward what you have miscalled 'the ultimate perfection.'"

The scientist stopped in front of an-

other cage that was empty, save for electrical apparatus.

"This general form of life now is indistinguishable from man," he continued. "But it exists. Certain groups of men will progress toward a higher stage of evolution. Others will lag behind, leaving another footprint in evolution's sands. It does not matter which individual race fathers the superman of the future. *For all races have an equal power to progress.*"

Riker's eyes twinkled. "I think you have made a misstatement, doctor," said the young biologist. "You have pointed out that some primitive forms of primates failed to progress. Others did. Why did not all forms progress? Why do we have the footprints?"

The doctor smiled. "They lacked the stimulus," he said. "I have caused rapid progress in living forms of such specialized primates as the spider monkeys and capuchins. I did this not in the usual way—in the manner in which fruit flies are exposed to cosmic rays to cause alterations or mutations in their descendants—but by altering the individual itself. I changed the creatures' entire cell structures by artificial fever!"

"The animals survived such treatment?" Riker was excited.

A low voice answered. It was Kathryn who spoke. "Most of the poor brutes lived only a week or two," she said. "One specimen has lived several years and is still alive."

DR. VON SHULER gloated. He beamed in his own glory. "Riker," he said, "I'm going to produce something beyond the power of imagination. I am going to create a man as he will be a million years in the future. I want you to see it."

He drew back the curtains of a near-by cage. This cage was not incased by glass, but by strong steel bars. Within, savagely baring his fangs, sat a huge gorilla.

It was not a true gorilla, however. There was a certain straightness about the animal's limbs. The eyes were more intelligent and more cruel. The hind legs were more elongated and the arms were shorter. The entire bearing was dimly human.

"Great Scott! Is that he?" cried Riker.

Dr. Von Shuler smiled and shook his head. "No," he said. "But it will be. This animal, three days ago, was a marmoset. I have brought him through a million years of evolution to his present form. It is a stage between gorilla and human, probably more closely related to one of the extinct great apes than to either. To-day I shall take my specimen further up the ladder. He will be human, then superhuman and then the——"

"The ultimate perfection!" whispered Kathryn. She looked at Riker, as if she expected him to object. Dr. Von Shuler, likewise, had his eyes on the young man.

Riker looked at the father and daughter. "I suppose," he said, "that I should object. I should say that I will have nothing to do with it. I should accuse you of tampering with nature and declare that I will have nothing to do with such an unholy venture." He smiled broadly, but nervously. "I confess that I do feel like a bad boy stealing apples from an orchard. But I was never so interested in anything in my life. Dr. Von Shuler, I am keenly anxious to witness the experiment."

Kathryn sighed deeply. She seemed to take on new life, as if a great burden had been lifted from her shoulders. "I knew you would," she said. "But there is danger. You must be willing to take risks."

"Danger?"

"From the artificial fever machine," Dr. Von Shuler hastened to explain. "It is different from the equipment used in most hospitals for the treatment of dis-

ease. It is more powerful and its effectiveness depends on the application of fever to the entire body at one time. The smallest ray from the machine is fatal, except to the subject. The subject of the experiment is treated with special injections of drugs, which allow life to continue with a fever of one hundred and thirty degrees!"

The gorilla stamped his foot and growled. It was as if the creature was impatient to begin his evolution.

A BARRED GATE, leading into a passageway connected with the machine-equipped cell, was opened in the gorilla's cage. The animal blinked sullenly, then slowly moved through the opening.

"Quite docile, eh?" Dr. Von Shuler smiled. "He was a beautiful creature as a marmoset—one of two I had shipped from South America."

"What happened to the other?".

Dr. Von Shuler looked quickly at the younger scientist. "That one," he said quietly, "resulted in my most successful experiment. You will see soon. These two were very much attached to one another. Soon they will be rejoined. We'll know from that if emotional development runs apace of physical development."

The ape stood before a huge wooden chair in the glass cage. For an instant he eyed the seat, mistrustingly. Then, as if he knew his cue, he sat down. Dr. Von Shuler pressed a button. From the sides of the chair metal irons clamped the creature's arms and legs in place.

The gorilla grunted savagely.

"The needle!" explained Dr. Von Shuler. "It has injected a solution into the creature's back that will enable the nervous system to withstand the high fever."

A motor in the room gave a low whine as it started to build up power for the experiment.

"Are you ready, Kathryn?" asked Dr. Von Shuler.

"Yes, father," she said. Her voice was tense.

"There's a switch behind you, Riker," said the scientist. "If anything goes wrong, pull it."

Kathryn moved into a shielded place at one end of the experiment chamber.

The whine of the motor raised its pitch steadily, then held the same tone.

"Ready!" called Dr. Von Shuler.

He touched a switch. The gorilla was bathed in light. The animal strained at its bonds at first, then closed its small eyes and drooped languidly in the chair.

It slowly seemed to change. The hair disappeared. The arms shortened. Then the brow seemed to raise in height and the chin grew more pointed. The change at first was so slow it was hardly noticeable.

"Miraculous!" gasped Riker.

The creature was more nearly a man than an ape.

"Pithecanthropus!" announced Dr. Von Shuler. "It's going to be a success."

The face of the subhuman man in the cage became more normal and the neck more slender. For a time the shaggy eyebrows alone remained of the apelike features. Then these, too, disappeared.

In the chair, where once crouched an ape, sat a man—a well-formed, handsome white savage.

"Father!" cried Kathryn. "I know him!"

"Kathryn!"

A cry of alarm broke from Dr. Von Shuler's lips. No longer was he a scientist. He was a father.

He jumped from behind his shield. He jerked the switch at Riker's shoulder. The whine of the motors lowered and the lights bathing the white savage dimmed.

The door of the glass cage opened and Kathryn sprang to the side of the

man in the chair. Her voice came in a peculiar, unintelligible chatter.

"Stop her!" screamed Dr. Von Shuler.

She was unfastening the metal bars that held the savage's arms. Riker ran toward the cage door.

Slowly, the creature in the cage opened its eyes. He saw Kathryn. His lips parted in a smile.

His arm slowly lifted and grasped the girl. The other arm circled her neck. With a grunt, the brute pushed her head back. There was a sickening snap.

Dr. Von Shuler screamed.

Riker was in the cage, facing the savage. He bared long, ugly fangs and started toward the young scientist. Then he lowered his head in a charge.

Riker struck, at the same time leaping out of the way. The blow caught the creature and sent him staggering against the glass walls of the cage. There was a crash. Jagged glass tore into the smooth, white flesh of the savage. Blood spurted about the cage.

The half-human creature jumped to his feet. He swayed unsteadily. Then he charged once more toward Riker.

The young scientist dodged again, but his leap carried him into a corner. The savage smiled. Riker could not dodge from a corner. He moved slowly toward the biologist. Riker ducked under the circling arms and punched viciously against the hard, abdominal muscles. He felt the hands close about his throat. But the grip was weak. The creature's hands slipped and then the half-human savage slumped to the floor. He had bled to death.

RIKER SAW Von Shuler rushing into the cage.

"Kathryn!" the man sobbed. He stooped over a still form on the floor.

What Riker saw was not Kathryn, but a small, dead marmoset.

"You said that one of your experiments had lived several years," murmured Riker. "Now I understand. It was Kathryn. She was not your daughter."

"She was my daughter," said Dr. Von Shuler, "a child of my science. The creature there was her mate——"

He pointed to the thing Riker had killed. Already the evolutionary processes were reversing in death. The white savage was becoming a marmoset.

Slowly, Riker turned away. He left the cage and walked through the halls. On all sides were curious forms of life, but none were so bizarre as the scientific animal behind him, who wept over a dead female marmoset.

Temporary Warp

"Space can be warped—on earth—but——"

by
Frank Belknap
Long, Jr.

"The warp will destroy everything in its path for at least twenty miles—everything within the zone will be convulsed by the bombardment."

THE GUN was a hundred feet in length, silvery and resplendent. It stood on the summit of a little hill bright with the russet leaves of autumn. At its massive, mushroom-shaped base two men stood excitedly talking.

Cyrus Wolfe was tall and stoop-shouldered. His darkly bearded countenance was haggard, melancholy and lean. He stood grimly regarding the great gun from beneath shaggy brows, his small, deep-set eyes dark pools of fanaticism in his young-old face.

Cyrus Wolfe's companion was a little man with rosy cheeks, snow-white hair

and the naive blue eyes of an impractical theorist and visionary. He was talking loudly, earnestly, disclaiming with violent gestures all responsibility for the gun and its contents.

He had merely speculated idly in the presence of Cyrus Wolfe. In Wolfe's imposing presence he had merely propounded a theory, not realizing that Wolfe was wealthy enough to test idle theories concretely, and that Wolfe was a man of evil instincts. He could picture Wolfe killing every soul in the world, and remaining immune to remorse.

Yet it had begun innocently enough. "I tell you, Wolfe," Wolfe's companion had said, "that space can be *warped*—really and truly warped. Einstein claims that all heavenly bodies warp space and that there is a terrific curvature in the region of the heaviest suns. But I tell you that right here on earth space can be warped."

It had all begun so suddenly, so casually. In Wolfe's library, over cups of steaming black coffee, with Wolfe the smiling, urbane host and little Winter excited and immeasurably flattered because Wolfe appeared to be interested in what he was saying. Henry Winter taught school in a township owned by Wolfe. The township had a puppet mayor who obeyed Wolfe implicitly in everything, and aldermen and school board were under Wolfe's thumb. Then there was the great steel foundry which belched red flames at night—a Cyclopean, mile-wide monster squatting in darkness, dominating the countryside.

That foundry—that monster was owned by Wolfe. The sweat-begrimed men who toiled in its red-lighted vitals lived in fear of Wolfe. Wolfe was a dishonest industrialist—a merciless taskmaster who ignored the welfare of his workers. He employed an auditor who winked at crooked accounts. All his employees were in debt to him. Every one in the township owed him money. He was ruthless, cunning, cruel.

Yet so devious is the human psyche that Cyrus Wolfe was tremendously interested in astrophysics, in relativity, in the cold, black abysses between the stars. Cyrus Wolfe liked to throw his thoughts audaciously outward toward the receding constellations, to speculate endlessly on the twin mysteries of time and space. Yet into these speculations went the same ruthlessness that characterized his commercial dealings. Cyrus Wolfe would have calmly doomed the world to prove a theory.

WINTER had set his coffee cup down on the edge of a Chippendale serving cabinet, had excitedly paced the floor.

"As you know," he said, "gravity is a curvature of space. Light stars curve space slightly, but stars of great density curve it tremendously, distorting light and hence obscurely altering the whole space-time picture. We don't know exactly what happens to space in the vicinity of stars of terrific density. The stupendous distortion may actually bring about a sort of kink in space time, and result in a reversal of entropy."

Wolfe stared at his pacing guest, a queer, intent look on his bearded face. "You mean, matter in the vicinity of such stars may be building up instead of breaking down?"

Winter nodded. "Yes, something like that. Of course, we can only speculate. Many—most physicists would deny that there is any kink, but I think there is, and I think that space time is obscurely altered."

"And you think that such a kink could be produced artificially on earth? Despite earth's gravity, despite——"

"Yes, yes, I do," interrupted Winter excitedly. "The gravity warp produced by earth is utterly negligible. But we could produce here, on a small scale, a curvature of space as startling and ex-

ceptional as the gravity fields of the heaviest stars."

Wolfe stared into the dark dregs of his coffee cup. "How would you set about producing such a warp," he inquired.

"I would bombard the atmosphere with high-voltage ions, until all its elements disintegrated. I would use the air as a target, blasting out alpha particles from all its atoms until electronic orbits of illimitable contraction appeared in the radiant ether. I would produce a field of energy heavier than the radiant force fields at the core of suns.

"You'd require elaborate apparatus, I suppose," said Wolfe, his eyes becoming glittering points of flame.

"It wouldn't cost very much to build," said Winter, not thinking at all of Wolfe's bank balance, not thinking of anything but his own spun theories, which fascinated him precisely as the web of a rare spider on a dewy morning would fascinate an alert entomologist.

"How much?" asked Wolfe.

"Oh, two hundred thousand dollars perhaps. But there would have to be an endowment. No single man of wealth would ever want to spend that much on pure science. Why, if men of wealth were *that* generous we could send a rocket to the moon now. Two little millions would build a moon rocket."

"Yes, yes," said Wolfe impatiently. "I know. We'll skip that for the moment. How would you go about bombarding the atmosphere?"

"I'd build an electric vortex gun of enormous magnitude," said Winter. "The centrifuge in its bore would whirl a fifty-per-cent mixture of hydrogen-one and its isotype about at a terrific speed. It would build up an energy charge of millions of volts."

"I see," said Wolfe. "And such a gun could be built for a quarter of a million?"

Winter nodded.

IT WAS on the tip of Wolfe's tongue to say: "I'll build it." But he restrained himself. Wolfe was discreet. He would need plans, specifications, advice. But he would wheedle them craftily out of Winter, without paying Winter a cent. He would pretend to regard the gun solely as a fascinating problem in speculative physics.

Winter furnished plans, specifications, advice. Eagerly, elatedly, he constructed a gun on paper, without suspecting that the workers in Wolfe's foundry were constructing a gun with blue prints and glowing metal.

He did not see the gun until it was finished. And even then he did not fully divine the depths of evil in Wolfe, the fanatical callousness which animated him. It was not until a clear, cold morning in mid-October—when the gun stood on a little hill, bright with the russet leaves of autumn, and pointed ominously across the quiet countryside, toward fallow fields and low stone fences and cattle grazing peacefully in purple-tinted hollows—that he awoke to the full enormity of what Wolfe proposed to do.

He argued, pleaded. "The warp will destroy everything in its path for at least twenty miles," he groaned. "Wolfe, think what you are doing? There are houses, villages within the zone which will be convulsed by the bombardment. The warp may even extend as far as Glendale, a town of fifteen thousand inhabitants. You can't murder all those people, Wolfe. You can't——"

Wolfe smiled coldly. His eyes were luminous with the chill fanaticism of a man without scruples and without remorse, a player at the chessboard of life who has used for pawns human beings, and grown weary of removing them, one by one.

"You're a sentimental weakling, Winter," he said. "Science will never advance unless it frees itself from the dominion of cravens like you. You fear the forked lightning and the blazing,

noonday sun. Remember what Nietzsche said: 'We must be ruthless and pitiless. We must make ourselves strong under heaven, if we are to advance from triumph to triumph.'"

"But to kill thousands of human beings, women and little children, is not to advance, Wolfe. It is to revert to the savage and the beast."

"Sentimental rubbish, Winter," rasped Wolfe. "Chances are, the bombardment will produce no warp at all. Chances are, your theories are the half-baked fabrications of a touched mind. But we'll see; we'll see."

Wolfe moved swiftly to the priming mechanism at the base of the enormous gun. A circular, domed mass of grid-surfaced metal mushroomed outward from the breech mount of its hundred-foot barrel, giving it the look of some colossal prehistoric monster crouching in armored menace.

Wolfe grasped a projecting lever and drew it slowly toward his lean, taunt body until a twelve-inch metal disk near the summit of the flaring grid hood began swiftly to revolve.

Wild despair flared in his companion's eyes.

"In the name of Heaven, Wolfe," he cried, "reverse that level. Now, now, before it is too late. Your hands are still white. You are cold and inhuman, but you have never killed in wanton caprice. A man without humanity may still live in peace with himself if he restrains the worst impulses of his nature. But a murderer can only know torment and unending remorse—only the agony of cruel——"

Cynical laughter drowned out the little man's voice. Wolfe had thrown back his head and was gazing at the blinding sun. Straight into the sun's great disk he stared, while laughter pealed exultantly from his distended throat.

"'Thus spake Zarathustra,'" he quoted. "'There shall come one remorseless, a superman, who shall slay without pity in the pride of his young manhood. Knowing neither good nor evil, he shall make himself invincible under the sun.'"

A violent trembling seized Winter's fragile body. He turned about until he was staring directly at the muzzle of the great gun. For terror-fraught, dragging seconds an ominous stillness seemed to envelop the peaceful countryside. The long stone fences, which divided the brown fields into checkerboard squares, cast lengthening shadows on the pasture lands beyond. The drowsy cattle were bathed in liquid amber.

Then, suddenly, the great gun spoke. The ground trembled and the long, gleaming cylinder recoiled with a blast like thunder. A cry of terror ripped from Winter's lips as the concussion lifted him into the air and hurled him with violence to the earth.

By some freak of leverage, Wolfe resisted the appulse of the mammoth weapon's recoil. He remained on his feet beside the grid hood, his pupils dilating in incredulous terror as he watched a mile-high curtain of radiant force move slowly across the sun-drenched countryside, distorting and flattening everything in its path.

IN A DARK, secluded corner of Glendale's most popular restaurant young William Lake sat listening to an eight-piece orchestra playing Chopin's "Allegro." His hand rested palm downward on the table before him. Nestling between his fingers was the slim, white hand of the loveliest woman in Glendale.

William Lake had never been so happy. His unbelievable good fortune filled him with such incredible joy that he could scarcely speak. The slim, lovely girl who was sitting beside him, the blue-eyed, golden-haired girl whose slender fingers he was clasping tightly, had promised to be his wife.

She was dressed entirely in white. A

radiance suffused her lovely countenance, shone in her clear, blue eyes.

William Lake was an attorney at law. He had passed his bar examinations at the age of twenty-one. He was now twenty-three. He had eight clients and his income averaged thirty dollars a week. But Helen Hunter was a modern young woman. Helen Hunter had a job of her own and she was firmly convinced that two could manage as skillfully as one.

Only one thing troubled her, clouding her almost perfect happiness. "Dearest," she murmured. "Women age so much more rapidly than men. When you are still middle-aged, I shall be—an old hag. Oh, I know that sounds ugly, but we must face it, Will. I am five years older than you."

"In fifty years you will still be young and radiant to me," he murmured. "Oh, my dear, as long as I live there will never be any one but you for me."

Helen Hunter smiled and nestled closer, resting her head on Lake's shoulder.

Suddenly Helen said, "I feel dizzy, Will. My head is buzzing. It must be very warm in here."

A look of concern came into Lake's face. He turned slightly and looked down in tender solicitude at the woman by his side. As his eyes focused on the upturned oval of her face, his cheeks drained pale and a startled cry burst from his lips.

Helen Hunter had vanished. The woman beside him was not—could not be Helen Hunter. A face shriveled and seamed and horrible rested upon his shoulder—the face of a woman so incredibly old that all expression had vanished from her features. Only her eyes were alive and tortured, faded blue pools in the awful desolation of her time-ravaged countenance. Only her eyes spoke to him—the eyes of Helen Hunter, the eyes of the woman he loved.

Blind terror engulfed William Lake. He cried out again and half rose from the table.

In frantic dismay the withered crone's clawlike hands went out and fastened on his wrists. Her toothless gums jabbered, "What is the matter, Will? Why do you look at me like that?"

Slowly, as he returned her agonized stare, the awful truth dawned upon him. The ghastly apparition who was clinging to him in senile despair was still Helen Hunter. He was gazing into the tormented eyes of a woman who had aged seventy years in a few seconds.

Fighting down his horror and revulsion, he drew her gently into his arms and kissed her wrinkled forehead.

"I will wake; I must wake," he muttered. "I have been caught up in some horrible dream. Helen, Helen, bear with me until this illusion passes, this madness ends. Your sweet face is hidden. I cannot see you as you are. But we are together still. No blackness, no horror can destroy our love."

FIFTEEN MILES AWAY two men were struggling savagely at the base of the largest steel gun ever cast. Below the hill, where they clawed and tore at one another, the landscape that had once stretched peacefully to the far horizon was terrifyingly convulsed. The level pasture lands had buckled into overlapping folds. Like the waves of a frozen sea they hung incredibly suspended between earth and sky, and upon them crawled huge, disklike objects that had once been cattle.

The outlines of the bombarded animals were still nebulously bovine. Their bodies were wavering, circular smudges of brownish hue, but they moved on attenuated legs and with long necks outthrust over the overlapping fields. An alien geometry held this fearfully altered world in thrall.

The distorted cattle were moving in concentric spirals, backward and forward

simultaneously—moving at right angles to the contorted fields and yet unmistakably across them. The hills had repudiated mathematics. They were no longer stably orientated in space. They wavered and coalesced and caved in upon themselves, dissolving in incredible spirals, buckling into alignments alien to three-dimensional physics.

Beside the great gun, Henry Winter was gouging Wolfe's flesh with his finger nails. In despairing desperation, the mild little dreamer was fighting to save fifteen thousand souls.

Wolfe gave ground slowly before the little man's savage onslaught. A grim urgency gripped Winter as he drove the other from the gun. He was fiercely determined to reverse the lever, to stop the still-whirring disk in the grid hood. He must prevent, at all cost, another blast from the automatically recharging breech chambers at the base of the terrible weapon.

Wolfe's eyes were venomously aglow. Snarling like an enraged beast, he directed fierce blows at the little man's head and shoulders—blows which the latter cleverly evaded. Winter's smallness was an asset. He dodged and ducked and weaved about agilely. He squirmed in under Wolfe's guard and inflicted merciless punishment. His hands raked clawlike across his antagonist's unprotected face. For thirty feet the struggling twain reeled and tottered backward across the summit of the hill.

Then Winter swung about. He leaped out of range of Wolfe's flailing arms and raced madly back to the great gun. Swiftly, he clambered over its massive base, tugged and jerked at the lever which controlled the priming mechanism.

A despairing cry burst from his lips. The lever had jammed. Stubbornly, it resisted the pressure of his fingers. For an instant he continued to frantically tug at it, his breath coming in labored gasps. Then Wolfe was upon him. They fought again beneath the grid hood, their bodies violently intertwining above projecting knobs of metal.

It happened suddenly—the reversal of the great weapon, the sudden shifting of its range. Wolfe's thrashing limbs collided with another lever a few inches beneath the breech mount, pushed it sharply sideways. Instantly, there arose a loud, vibrant thrumming which drowned out the fainter hum of the revolving wheel in the grid hood.

Slowly, the long barrel began to turn. The distorted and convulsed fields passed out of range of its sinister trajectory before the two men realized what was happening. Locked in a fierce, muscular impasse, they were too agitated to realize that the metal beneath them was steadily moving.

It was not until the gun was pointing directly across another stretch of countryside, a bleak, denuded vista covered with stubble grass and stretching away to smoke-enveloped horizons, that they awoke to the horror of their predicament. But it was too late. The great gun spoke again before they could descend from its base, spoke in accents that shook the earth, hurled Winter and his companion forty feet through the air, and reverberated through the massive stone walls of Wolfe's iron foundry seven miles away. Directly in the path of the space-warping force curtain was the great, sprawling beast which belched fire at night.

"APE" JEPSON was built to endure. He had a square, massive face, huge hands and feet. His body was barrel-shaped, incredibly thickset. His voice snarled or roared in his throat. His eyes were deep-set, small and unintelligent. His face was almost apelike in its primitiveness. Across his low forehead dark, oily strands of hair straggled repellently. His thick lips were set in a perpetual sneer.

He was holding a white-hot bar of

metal in tongs so huge that they would have weighed to earth a man of normal physique. He was standing on a projecting ledge of metal, gazing downward into a forty-foot cauldron seethingly aglow. Far beneath him little men in black, with glare-protected eyes, swarmed like ants over Cyclopean, red-lighted annealing ovens, blows and mandrils.

Ape Jepson raised the tongs and brandished them proudly, his great biceps swelling.

"See you," he said. "This is a man's work. It is a man's work I do. I do not sit and read from crazy books like you. You are so weak, like a baby."

The man addressed raised his eyes and smiled tolerantly through thick-lensed spectacles. He was in all respects the exact opposite of Ape Jepson. He had a thin, scholarly face, a thin, frail body. His eyes were as blue as the summer skies—a light, cold blue. In his white, uncalloused hands he was holding a small book.

He was leaning against a rail which terminated at the ledge on which Jepson was standing. Thomas Wilder knew steel. He had forgotten more about steel than Jepson would ever know. Despite his physical frailness and myopic vision, he was the ideal supervisor in Cyrus Wolfe's foundry.

"Do you know, Ape," he said, "the more I study you, the less I admire brawn for its own sake. You are sheer, unadulterated brawn. And because of that you are not even dominant, not even manly. You are just a lumbering lump of subservient flesh. My brains rule you, guide you, control you."

Ape Jepson looked bewildered. He shuffled his feet and chewed at his thick underlip. "What kind of talk is that?" he muttered. "I am master here. If you want to cast iron, you got to lift it like I do. It is a man's work."

"Ape," said Wilder, "you remind me of certain animals that walked the earth millions of years ago. Did you ever hear of dinosaurs, Ape? They were larger and stronger than twenty elephants, but in their big heads they had tiny, pea-sized brains. They could have lifted steel, too, Ape."

"Foolish, crazy talk," muttered Jepson thickly. "There ain't no animals lived that long ago."

He drew himself up again, spat contemptuously. He raised the tongs he was holding, swung the glowing metal in a wide arc—swung it but did not hurl it.

A cry of unearthly terror bubbled from his thick lips, as he arrested his arm in mid-air. Out of the floor of the great foundry far below there had loomed a colossal shape which filled all the space where the cauldron had been and all the space where little men in black with glare protectors on their heat-blistered faces had climbed over the enormous annealing furnaces.

The shape was moving and alive. It was a vast, leathery bulk which glistened in the lurid light of roaring blast furnaces, that shook the foundry with its lumbering tread. It was reptilian in contour, with an enormous, lizardlike head, a wide, flaring neck and little, dark eyes malignantly agleam. Its sinisterly gleaming jaws were rimmed with long, sharp teeth which glittered more sanguineously than the lizard flesh on its quivering flanks. Slowly, awfully it upreared until its teeth-studded jaws were within a few inches of Ape Jepson's horror-frozen form.

Wilder was horror-frozen, too. His spine congealed as he clutched the rail before him and stared down at the slowly uprearing monster. "An allosaurus," he cried, his voice vibrant with consternation. "A carnivorous dinosaur of the Jurassic Age—the most frightful engine of destruction that ever walked the earth!"

The name meant nothing to Ape Jepson. He had eyes only for the great,

leathery face so near to him, the glittering, tooth-rimmed jaws that yawned to engulf him. He screamed and hurled the glowing ingot straight at the huge beast's wide, flaring neck.

With a sibilant hiss, the white-hot bar of metal whirled through the air, thudded against quivering, reptilian flesh. A roar of pain and rage welled from the great saurian's throat. In blind agony, it turned about and moved swayingly from the ledge which supported Jepson and his companion. An acrid odor of burning flesh surged sickeningly on the tainted air.

WITH a painful effort, Cyrus Wolfe arose to a sitting posture and stared dazedly about him. Forty feet away the great gun stood immobile, its contents expelled, slumberous now under the clear autumn skies. But below the hill chaos and horror reigned.

To the west stretched the pasture lands that had repudiated mathematics. Still in the throes of unnatural convulsions, they wavered and receded terrifyingly, while the flattened, diskilke cattle moved erratically across them.

To the east stretched another world convulsed. The stubble fields had heaved up into great overlapping tiers that stretched skyward at incredible tangents and pulsed with a pale-violet light. As Wolfe stared, horror-stricken, he perceived that the world to the east was more aggressive than the world of unnaturally contorted pasture lands and long stone fences.

It did not merely hover in multidimensional fluidity a hundred feet from the muzzle of the great gun. It moved slowly in Wolfe's direction, the glimmering tiers seeming to retreat as they advanced.

But advance they did, slowly, relentlessly, nearer and nearer to where Wolfe sat with a broken ankle and wildly staring eyes. Wolfe was staring with a freezing sense of terror surging up in his breast at an incredible object which was moving toward him across the tiers. It was vaguely like the disk-shaped cows in the convoluted pasture lands, but larger, more ponderous.

Its body was a huge, circular smudge from which a long, tapering cone projected waveringly backward into space. It moved on stumpy, wavering legs, backward and forward simultaneously, and its vast neck was outthrust for one hundred feet beyond the quivering circle of its incredibly flattened body.

It seemed to be fleeing as though in panic, down and across the tiers, moving swiftly nearer to Wolfe with every yard traversed. And, suddenly, it was upon him, its vast, impossible body descending vertically, crushing him swiftly and terribly to earth.

The next instant it was gone. The air about it seemed to swirl in upon it, to swallow it up. Where its great bulk had been there yawned only a quivering void.

It was some minutes before consciousness returned to Henry Winter. The recoil of the great gun had hurled him so violently to earth that his entire body was a mass of bruises. His legs tingled and his head throbbed and ached. But, resolutely, he struggled to his feet and stared about him—stared in stunned incredulity at a normal world.

To the west of the hill stretched unmoving brown fields bisected by long, stone fences. In purple hollows contented cattle grazed. A drowsiness enveloped the autumn landscape, a pervasive peace. To the east peace reigned, too. The mellow rays of the slowly westering sun relieved the somberness of stubble fields which stretched away to smoke-wrapped horizons. Nowhere was there a hint of distortion or abnormality. Nature had resumed her three-dimensional sway.

There was only one repellent note:

crushed and incredibly mangled, the unmoving body of Cyrus Wolfe gleamed gruesomely in the warm autumn sunlight forty feet from the great gun that had warped space.

WINTER tried his best to explain what had happened to the reporters who clustered about him the following morning. He sat propped in bed and returned their incredulous stares unwaveringly.

"I know it seems unbelievable, gentlemen," he said. "And I cannot, of course, blame you for thinking me a little touched. But this is what really happened. Space time was warped slightly. The Einsteinian space-time continuum buckled into shallow folds and then *straightened out again*. The warp was merely superficial.

"Because it was superficial, only a little of the past, a little of the future broke through. The folds of the warp distorted space time evanescently, erratically skirting the vast gulf where the past lies buried and lightly tapping the vast stores of the future.

"It is a truism of modern speculative physics that the past and the future exist simultaneously and coextensively in higher dimensions of space. De Sitter has speculated as to the possibility of seeing an event before it happens. It is quite possible, gentlemen. Events of the far future already exist in space time.

"You tell me that a woman in Glendale became incredibly old in a few seconds and then returned to glowing youth and beauty in her lover's arms."

He smiled a little. "I'm glad that happened, gentlemen. I mean, I'm glad she became young again. Apparently the warp was very feeble when it reached Glendale. A thin thread of force warped space very slightly where the woman was sitting, so slightly that it missed her companion completely.

"She became an old woman for an instant, was projected forward in time. Her surroundings remained stable because the warp was so slight that it only enveloped her body. Then the warp straightened out and she became young again.

"You tell me that two men saw an incredible beast in Wolfe's foundry. They swear it looked like a dinosaur. I think it was a dinosaur, gentlemen. It broke through when the warp tapped the past."

"And what killed Wolfe?" exclaimed one of the skeptical reporters belligerently. "What trampled Wolfe to death? Was that a dinosaur?"

Winter smiled wanly. "I think perhaps it was the same dinosaur," he murmured. "But, of course, we'll never know for certain."

Not far in the future—it lay—

JUPITER

DEVEREL had had seven hours' start on Colbie; it had taken the officer of the law that long to float down to Vulcan's surface after the action of expanding gases within the tiny planet's interior had vomited him miles above it. In those few hours Deverel had had the opportunity to vanish into any direction; yet Colbie, using a canny process of elimination, tracked the outlaw to Ganymede.

Not, however, that it did him any

Jupiter was flashing dizzily, first through one plate and another, with the whole heavens whizzing around it—then Colbie was thrown backward.

TRAP

A Novelette

by Ross Rocklynne

A nasty planet—so big and unconcerned with the rest of the system——

good. Colbie was a good man to have in the interplanetary police force, a smart man; but he lacked the ability to let his imagination run rampant. Deverel was different; behind his smiling, cynical eyes was a mind that worked with the swiftness of lightning, a mind that never admitted defeat. Or perhaps it was simply that the forces of nature allied themselves with him, gave him hints of secrets that Colbie was denied—as in the Jupiter trap, for instance.

Colbie didn't *know* that Deverel was on Ganymede; he merely suspected it, and fervently hoped that it was so. He knew that all the minor planets—Mercury, Venus, Earth, Mars—were all on the other side of the Sun at that time, and to plot a successful course around the Sun takes a great deal of time and mental energy, the first of which the outlaw had none to spare, the second of which he would not have had the patience to make use of.

He also knew that Jupiter, and its family of worlds, lay in conjunction with Vulcan, that Deverel was running dangerously short in rocket fuel, that it was much less costly to travel in a straight line by first building up velocity and then coasting the rest of the way to Jupiter, where, at Jupiter City, he could refill his tanks.

So Colbie set his course for Jupiter. But, since he, too, was short on fuel, he also had to coast.

It took him ten days to cross that frightful gap between large and small planet, and when he did get in its vicinity, he was tired from the constant watch for meteors. He discovered that Ganymede, Jupiter's second-largest moon—diameter, thirty-two hundred miles—was less than ten thousand miles away; so he made up his mind to land there. Later, he decided Deverel would have experienced the same fatigue, and would have landed also.

Having come to this satisfying conclusion, he had to use further logic in determining at what point Deverel would have landed, but there was a comparatively simple solution to this problem. Years before there had been a fueling station on Ganymede, established to accommodate the great liners that had to make the long trips from the minor planets out to Pluto. But that was before man had learned how to combat the crushing atmospheric pressures and gravitations of such planets as Jupiter, Saturn, Uranus and Neptune, by the invention of the Jupiter suit. The fueling station—relocated now at Jupiter City—had been abandoned, for the raw materials of rocket fuel were to be found in inexhaustible quantities on Jupiter.

But the buildings were still standing, since the weather effects on Ganymede are practically nonexistent, and any Earthman would have been drawn to their vicinity as if by the action of a magnet.

The unmanned station was located on the floor of a small valley that received more Sunlight on the average than any other spot on Ganymede. When it had been built, that had been taken into consideration. Ganymede always presents one face to Jupiter, in its week-long orbit around the planet.

COLBIE went to the valley, skimming the rocky, tumbled surface of the planet so that Deverel would have little opportunity to glimpse him from afar. Literally, he stuck his nose over the lip of a precipice that fell sheer to the floor of the valley some hundreds of feet below. The valley was not wide, but it was fairly long. The Sun was the size of a dime, and the mountains threw short, dim, conflicting shadows.

What Colbie saw far exceeded his expectations. Exultantly, he spiraled the ship back up, then zoomed down into the valley. Meteorlike, he cut as near to the edge of the precipice as he could. He turned the ship's nose down, and the ground came up, like a big white hand,

to slap him. He jammed on the fore rockets, and grunted under the sudden deceleration produced. The ship came down lightly, settled to rest behind one of the large limestone boulders that lay in profusion across the floor of the valley.

He hurriedly locked his controls. He put on a space suit. Probably he could have stood the outside temperature, or even the thin air, but a space suit provided for both in a comfortably generous manner.

He swung open the port hatch, leaped out onto the ground, which was composed of a near-white, frozen, vegetationless clay. He stood looking about him. All was silent, motionless—as silent and motionless as only a lifeless planet can be.

Colbie stuck his head around the curve of the limestone boulder. About three hundred odd feet away lay a long, black cruiser. Less than a hundred feet from the cruiser was the shine of an icy lake, worn smooth by thin, timid breezes. On the opposite shore of the frozen lake were three buildings, all in various stages of disrepair, but, in the main, intact. The buildings were not high, but they were long. They had been used to store thousands and thousands of gallons of rocket fuel.

Colbie had been right when he supposed that those structures, so reminiscent of Earth and its peoples, would draw Deverel to their vicinity.

He remained hidden behind the aged, dirty-white boulder. He smiled to himself. Somberly, he swore to himself, that *this* time Deverel would go back with him.

He waited for Deverel to put in an appearance. His patience was his stanchest quality. He became a part of the landscape itself, though he imagined he was well enough hidden from the outlaw, since almost certainly he was leisurely inspecting the crumbling interiors of those lonely, deserted edifices across from the lake.

Colbie waited less than an hour. Then he stiffened, came to his feet. He saw Deverel, and, though four hundred feet of distance shortened the figure of the man, Colbie was sure it was he. He drew his projector, made sure it was charged, and waited.

II.

DEVEREL came from the building, sauntered slowly toward the lake. He stopped on the shore of the lake, reached out a foot to test its strength, though that must have been a habit of Earthly experience, since for ages the lake must have been frozen solid to its bed. Then he was out on it, walking across slowly.

The outlaw set foot on the barren soil of the lake's shore, and Colbie jumped out from behind his hiding place, and, without parley, pulled the trigger of his weapon. Less than ten feet from where Deverel strode along, a geyser of powdered soil and rock spurted violently into the air.

Colbie shouted at the top of his voice. "Stay where you are, Deverel."

But, ever quick to respond to the stimulus of danger, Deverel did not stay where he was. Near him was a small limestone boulder. He threw himself behind it. Colbie fired again, just missing the outlaw.

There was a moment of tense silence. Then Deverel began to fire back, a steady blast of explosive projectiles that was not intended to annihilate Colbie, but merely to demolish the limestone mass behind which he was hidden.

Colbie had dived behind his shelter again, scared by the vicious fire. But he made ready to adopt Deverel's own tactics. And there he had Deverel at a definite disadvantage.

Calmly, he began to whittle the smaller limestone boulder down, beginning at the top, and progressing more slowly as he came to thicker portions. The thin air became a receptacle for vol-

tunes of sound. Powdered rock rained about Colbie. Sometimes larger particles fell on him; but he was not hurt, for gravitation here was slight.

He won sooner than he expected to. He had almost demolished Deverel's protection entirely, when a projectile caused it to split down the middle. The two halves fell away from each other, rolled a short distance, and then settled to rest. Deverel, flat on the ground, lay exposed. For a few seconds, he half-heartedly continued his fire, and Colbie, grinning, allowed him to do so.

Finally, Deverel stood up, shouting out loud, blending both chagrin and admission of defeat into his tones. He threw his weapon in the policeman's direction, and then held up his hands in token of surrender.

COLBIE ran across the space separating him from the other, grinning his triumph.

"Hello, Colbie," he said uncordially.

Colbie returned the greeting, and stood looking at the larger man with an exultation which, out of politeness, he tried to conceal.

"Don't look so smug," Deverel snapped, and added in exasperation. "How did you find me?"

Colbie told him. Deverel nodded, a grudging respect in his blue eyes. "That was good work, damned good work. Going to take me back to Earth and jail, aren't you?"

"I was thinking seriously of that."

Deverel scowled. "All right. Let's get started. But I'll tell you this: I don't think I'll go back. I don't know why, either. But I place a lot of faith in miracles."

"It will be a miracle that lets you escape me this time," Colbie promised grimly.

Once within Colbie's ship, the outlaw was placed in irons. Colbie was taking no chances. He put Deverel in the control cabin, right where he could be seen.

Then he applied the power. The ship grated on the frozen soil of the planet, then swooped upward at a steep angle, swooped upward until the Moon drew its horizons together, until Jupiter, monstrous and dangerous, loomed into view, its multicolored face changing both form and variety of color.

Colbie happily piled on acceleration, followed a temporary trajectory to Earth until he could get busy and plot a precise one. But his satisfaction at the agreeable turn of events left little room for the maximum of caution he would have had otherwise.

Deverel sat motionless in his irons, resigned to his fate, within certain limits. He was watching Jupiter, and his thoughts were grim. He didn't want to go back to the hell holes on Mercury that they called jail. But at present, he couldn't see any way out. If only something would happen, one of those miracles he had so hopefully alluded to——

Almost as if his thoughts were conscious prelude to the event, before their minds could grasp the reality of it, the ship was turning head over heels in space. Jupiter was flashing dizzily first through one plate and another, with the whole heavens whirling around after it as if they were deliberately chasing it. Colbie was thrown backward against the air-defining machinery. Abruptly, there was a sharp hiss as a tender glass tube broke under the impact. He bounced across to the opposite wall, then plunged toward the nose of the ship to collide, destructively, against the instrument panel.

Deverel was sitting tight in his irons, watching with wide eyes as the lights went out. On the instrument board a few bulbs were still burning, and the vision plates were still in operation. Deverel watched the jigsaw of motion. A massive encyclopedia, that had somehow found its way from the living quarters aft, came along. It hit Deverel on the side of the head. Other loose articles

began to bombard him, but he was helpless to fend them off.

THERE WAS an eerie sense of downward motion, now; the outlaw supposed that it was downward in respect to Jupiter. He watched the mad hodgepodge with the wonder of a child. Colbie, desperately trying to secure a handhold, continued to jerk from one side of the ship to another. Almost battered out of his senses, he accidentally hooked his fingers around the starboard guide rail, and he hung on grimly, clearing his head.

He worked his way around to the instrument panel, and, with what few control levers he had not damaged in his mad flight about the ship, he tried to get the ship on an even keel. There was no response. He tried again. But it was useless. Swearing beneath his breath, he realized that one of those rare accidents had befallen him: although the ship had been traveling at a good clip, a meteor had caught up with it from behind and smashed itself into the stern jets, leaving them fused and useless.

He stood as still as he could, thinking seriously, and heard Deverel murmur with humor, "You were taking me back to Earth. Go on with the story from there."

"Don't be a fool," Colbie snapped coldly. "Do you think this is your miracle?"

"Maybe it is," Deverel said casually. "We're falling toward Jupiter."

"That doesn't mean anything! Not a thing—except that when we land we'll be lost, so lost that it'll be child's play finding that needle they used to talk about!"

Frantically, he worked at his controls again. Definitely, the jets were fused beyond repair. More than that, the lights wouldn't go on; nor were the air rectifiers working. Colbie found himself unable to right the ship by any means, and there is a sickening sensation in the feel of a ship that is not using an axis formed by stem and stern to twirl on.

Finally, Colbie got out the Jupiter suits.

"'Men—three cheers for the Jupiter suits,'" sang Deverel, taking the line from a popular ballad. He hummed through the bars of the tune and then ended, "They say you can't die in a Jupiter suit. That's almost the truth," he added, and quoted again, "'You can't get cold and you can't get hot, and the alloy won't crack, no matter what'!"

"It's lucky I have them," Colbie remarked. "Just before I left Earth, the force finally got permission to equip its ships with a couple of the suits each. They're pretty costly; people are allowed to use them only on the big planets, where they have powerful gravities and thousands of pounds atmospheric pressure. They say the alloy they make them out of resembles neutronium, which is about the heaviest substance known, and the hardest. That's why they're so costly, and why they're distributed around so sparingly."

He took Deverel from the irons, pointed to a Jupiter suit. They clambered into the bulky affairs.

The ship was still spinning in that sickening way. Colbie felt sick. Deverel was smiling weakly. "Let's get out," he suggested, as they buckled down their helmets.

Colbie's head was reeling. He was trying to think clearly. He went to an aft compartment, got a pair of handcuffs. He came up behind Deverel, snapped one cuff around his wrist, and the other about his own.

Colbie opened the hatch. There was a gust of air that rushed out into vacuous space and dissipated itself in an expansion that might eventually have touched infinity. Colbie pushed the outlaw after the air, and perforce followed immediately after.

The ship was long and black beside

them. To other sides was the starry sky, a sky which, from the interior of a hermetically sealed ship is bewilderingly grand and awesome, even to the initiated, but from without is domineering and frightening. There is no bottom to space. It is an awful sensation to fall——

THEY WERE falling, and the ship was falling with them. It was still spinning, though, and dangerously. The two men placed their space boots against the ship, succeeded in shoving themselves from its immediate vicinity. Twenty or thirty feet away, however, it continued to fall with them, true to the axiom that all bodies, no matter what their shapes, sizes, or weights, will fall at equal velocities, providing there is no atmosphere to affect them otherwise.

They felt no sense of weight; their very motion, being the effect of Jupiter's gravitation, was its cancellation. There was nothing but the tiniest sense of acceleration.

Below was the great, poisonously colored disk of Jupiter. In fascination, they watched its gradual growth.

Deverel broke the silence by murmuring, "Jupiter, hard, mean planet—I wonder how he'll treat us. We're liable to land anywhere, Colbie, anywhere on its billions of square miles. Jupiter City might be conceivably less than a hundred miles away, or more conceivably, a hundred thousand. In either case, we wouldn't have the food, air, or luck to get more than fifty miles. That planet is pock-marked with all sorts of mountain ranges, valleys, gorges, and every kind of un-Earthly river and sea. There are big lakes of acids, liquid ammonia, liquid oxygen, and Lord knows what other stuff. It isn't a pretty prospect."

III.

LATER, many, many hours later, Deverel suddenly gestured. "There's the great red spot, Colbie—just on the rim. That's good, mighty good. It means we may fall somewhere near Jupiter City, if we watch our weights."

Colbie saw his line of reasoning. The spot, shooting up over the western rim of the planet, would, since Jupiter rotated on its axis in ten hours, disappear over the eastern rim in about five hours. Three hours later, Jupiter City, located on the equator, where gravitation and atmospheric pressure were considerably less than elsewhere, would then be working up over the western rim. Two and a half hours would bring it beneath their present position in space. That gave them ten and a half hours to land.

They could do it, if they regulated their weights. Jupiter suits were necessarily equipped with gravity controls. Of course, out here in space, any variation in their weights meant nothing so far as their downward velocity was concerned, but the moment they struck the atmosphere, it *would* mean something. By decreasing their weight they would decrease inertia, and thus increase the ability of the atmosphere to resist their passage through it. They would fall more slowly, and, if they were careful, they *might* land somewhere near Jupiter City.

The spot, still an enigma in the minds of all men, sloped down the curve of the planet, and disappeared, leaving the breath of a red glow after it. The glow disappeared.

Acceleration had been increasing rapidly. They were so near the planet that it almost blotted out a whole quarter of the sky.

Thirty-eight hours after deserting the ship they felt a new force being evoked about them, and the stars above had suddenly gone almost imperceptibly dimmer; it meant that they had entered the vast atmospheric envelope of the planet.

The stars were taking on distorted appearances; here, where the atmosphere was thin, they even twinkled a little, strongly reminiscent of a little green

world which Colbie was beginning to feel he would never see again. Deverel seemed above such sentiments, or at least did not reveal their existence.

He seemed fascinated more than anything else. "I've been on Jupiter only once," he confided. "It was before I began pirating canal boats on Mars. Jupiter's a nasty planet, all right, but it's always interested me. Maybe because it's like me. It's so big, and so unconcerned with the rest of the system. It rolls along out here, takes its leisure going round the Sun—twelve years—and drags nine planets along with it, whether they want to go or not. It's a big chemical workshop. All sorts of marvelous things take place on its surface. It has such a high atmospheric pressure and gravitation that it seems it could do anything it wanted to in any element. When you think about it, it makes you glad you've got on a Jupiter suit."

They could talk without use of radio, now. The atmosphere was thick about them and carried the sounds. The stars were going out and it was becoming utterly dark. There is no Sunlight on Jupiter's surface, for the gas blanket completely absorbs or else reflects what little light the Sun can send that far.

They began to decrease their gravity potential. They still had a little over three hours to fall, and at their present rate of speed they would strike the surface of the planet much too soon to leave them within walking distance of Jupiter City.

They watched their chronometers closely, and, because of that fact, time seemed to plod.

They estimated their height above the planet as being only a few miles now, and they experienced sensations of crawling fear. They were falling into darkness, onto the surface of a planet five and a half billion square miles in area. They had estimated the time of their falling as well as they could, however, and, if they had overlooked nothing, Jupiter City *should* be somewhere near, within a five-hundred-mile radius; though, of course, five hundred miles was as bad as a million, so far as traversing it was concerned.

THEY LIVED in a world of small, enigmatic noises now. All sorts of noises were rushing up at them from below, above the whir occasioned by friction of their suits with the atmosphere. What were they? Animal life? Avalanches? Or rushing steams? Probably the latter, thought Colbie, or perhaps there was an ocean of some hellish liquid chemical down there, waiting to engulf them. He shuddered.

There were moments of tense waiting. Their nerves were keyed up for the first contact with the surface. It was exhausting. They didn't converse. They only stared down through blackness, vainly trying to find out how far they had to fall. Colbie could have introduced some light into their situation, had he gathered enough presence of mind to remember the search beam built into the breast of his Jupiter suit; but he didn't remember it, nor did Deverel; otherwise they would have saved themselves a good deal of the horror of uncertainty.

Colbie felt a constriction of fright. Something had brushed against his boots.

They touched again. Something had reached out from the darkness with light fingers, or so it seemed. Deverel let out his breath in a loud sigh. They tried to remain in a vertical position so that they might retain a sense of equilibrium should they strike some horizontal surface. But they couldn't. Slowly, they fell sidewise, frantically reaching out with hands that touched nothing.

Again they brushed a surface, and this time began to roll in crazy, slow motion down a steep slope. Abruptly, they came to rest on a hard surface. They lay there, motionless, after that ordeal in which nerves had suffered considerably

more than anything else. And they became aware of a constant, forceful bombardment of little missiles that struck them from above.

IV.

SIMULTANEOUSLY, they jumped to their feet in that pitch blackness.

"What was that?" chattered Colbie, as the bombardment continued. Deverel was silent and then laughed. He reminded Colbie of the search beams built into their suits, and snapped his on. Colbie sheepishly slid aside his breast panel and did likewise. Twin shafts of light leaped out, partially piercing masses of swirling white gases.

The little missiles turned out to be nothing more than swiftly falling drops of a white liquid.

"Rain?" exclaimed Colbie, in brief astonishment.

"Must be liquid ammonia," corrected Deverel. "Jupiter doesn't bother with April showers, you know. No, it's so cold there couldn't be any liquid water. It's all ice, and there's probably little of that. They have to make their own water at Jupiter City. But this must be liquid ammonia; this 'rain' is colorless, looks like water, in fact."

Colbie flashed his beam about. He got a blurred impression of swirling white gases, of constantly falling rain. Close inspection showed that the stuff they trod on was worn almost frictionlessly smooth by the eternal fall of liquid ammonia. It had a gradual slope to it, and they followed this slope up until they came to a satin-smooth wall.

Colbie played the beam about, and found it to be a thick spire of basalt that rose up for a short distance, then leveled off. It was this they had first struck. They walked around the column, found it almost perfectly symmetrical. At its foot the rock sloped down at a uniform angle. They started walking down the slope. They came to what looked like a pool of water. Colbie assumed that it was liquid ammonia. He flashed his beam across this obstruction and brought into stark view a vertical black wall, down which streams of liquid ammonia were running in hasty rivulets. It was about forty feet across the ruffled surface of liquid ammonia to the wall.

Colbie discovered that the wall rose upward indefinitely, for his beam revealed no single break in it. Nor was there a single break in the escarpment to either side. It rose vertically, unflawed by the merest suggestion of a handhold.

THEY FOLLOWED the curve of the land, constantly examining the escarpment. After walking for fifteen minutes, they discovered this fact: that, although the escarpment receded at times, drew nearer at times, there was no slightest deviation from its absolutely vertical aspect.

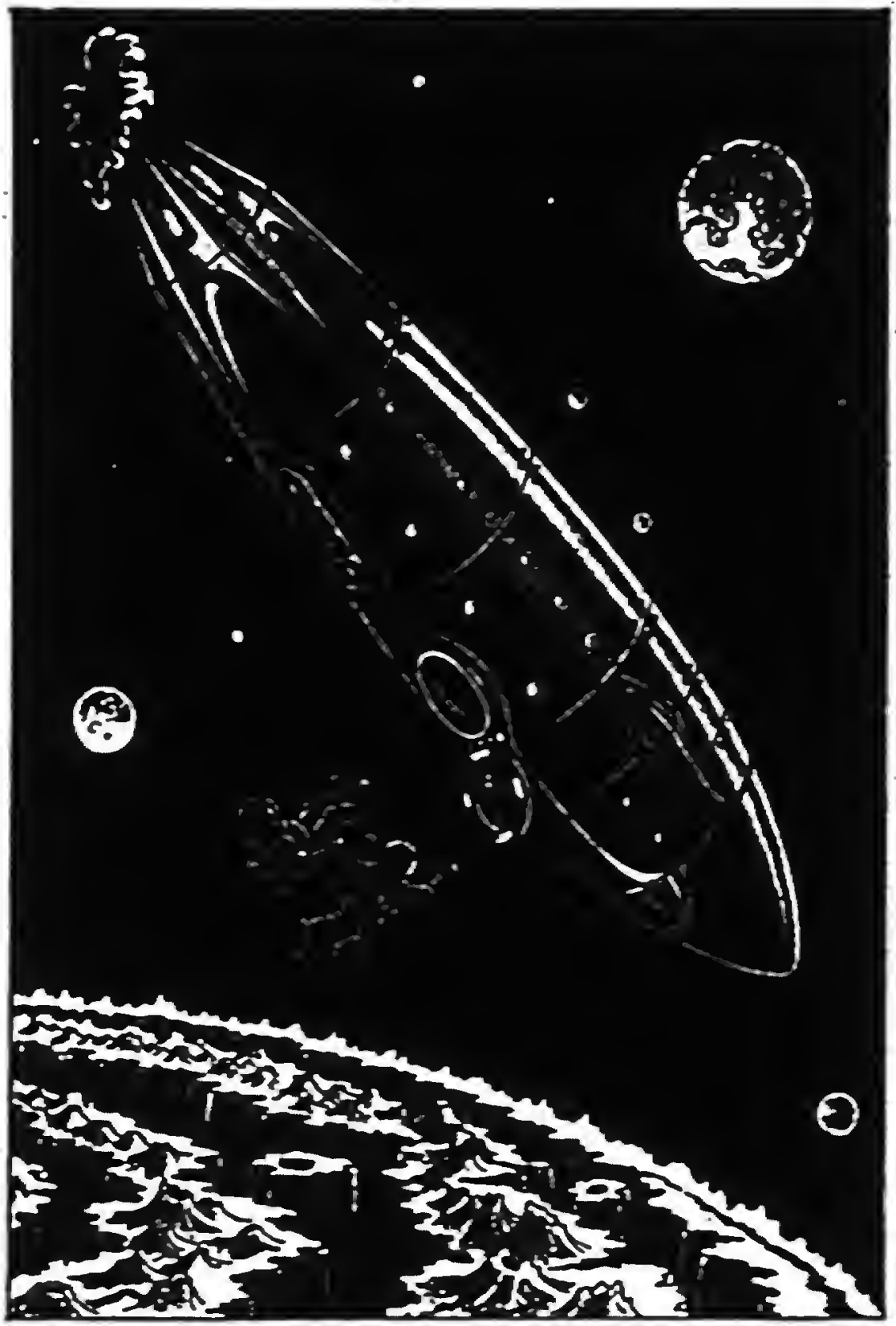
Colbie stopped suddenly, thinking. Then he started walking back up the slope of the land, Deverel perforce following. A minute's walk brought them to the spire they had first examined; and Colbie gave vent to an exasperated curse.

He smiled sourly at Deverel. "Do you see it?"

"See what?"

"That we're on an island! An island in a lake of liquid ammonia; and the lake bounded by the most damnably vertical walls I ever saw." He grunted disgustedly. They fell silent. The rain fell constantly, forcefully, while they stood there, baffled and angry. But one could hardly remain angry at circumstances which anger could not affect.

Deverel was still secured to Colbie by handcuffs. Now he simply twisted his hand slightly; there was a brittle, cracking sound. Colbie whirled like a



They felt no sense of weight; their very motion, being the effect of Jupiter's gravitation, was its cancellation. There was nothing but the tiniest sense of acceleration.

tiger, his projector out, a snarl contorting his features.

"No alarm, lieutenant." Deverel smiled. "Why should we tie each other down, since we're in such a bad fix. The cuffs would have snapped anyway. That alloy snaps easily in cold like this—not like the Jupiter suits."

Colbie remained poised in angry uncertainty for a few seconds, and then relaxed, viciously shoving his projector back into its holster.

"What do we do now?" asked the outlaw.

Colbie smiled cynically. "We stand here a while. Then we sit down. Then we get up again. Then, like everybody else slated for death, we'll manage to scrape up some false hope, and we'll take another look around. Then we'll sit down again."

"Interesting." Deverel commented quietly. "I suppose that goes on *ad infinitum*. I don't like the routine, myself. Well, let's sit down anyway."

They sat down.

There was a long silence.

There were gently fitful winds of ammonia gas. Sometimes they could hear the lapping of ammonia against the escarpment. The ammonia rain continued; its fall produced a constant, distantly drumming sound in their ears. But, all in all, these sounds just emphasized the eternal changelessness of the place.

Colbie had the feeling that if he sat there much longer he'd become just as unchanging. His nerves were at the snapping point. Snarling to himself at his impotence, he sprang to his feet, ran to the lake's edge. He followed the shore, flashing his beam in all directions. Deverel watched him disappear into the mists.

HE SAT MOTIONLESS, a phantom smile on his face. Whenever he thought deeply, he always wore that phantom smile. He was arriving at various conclusions which might or might not mean something.

When Colbie came back, he said, "Sit down, lieutenant. Your search has been fruitless."

Colbie sat down.

Deverel lay back on the smooth stuff of the island, sighing. "You know, Colbie, it's entirely possible that we're near the settlement."

"I suppose so," answered Colbie indifferently.

"It's nice to think of the place, isn't it? Especially since it seems as if we'll never see it.

"It's fitted up pretty comfortably. There's Earth food, running water, heated rooms, shows, dancing places, and newspapers—old newspapers. It certainly seems a dream to have that domed city so near and yet so far.

"It's mighty unfriendly outside the dome. Gas everywhere. You can hardly dignify it by the name atmosphere. Red, green, yellow—poisonous stuff—cyanide, ammonia, sulphur. Near the city are mountains, which rise to heights of four and five miles, like knives, and then drop down almost vertical on the other side. Man doesn't know much about them. But he's got the territory around Jupiter City pretty well mapped out, for a radius of thirty or forty miles.

There are lots of interesting things in that area—geysers and lakes and things like that; all full of a variety of chemicals in a liquid state. There's the Fountain—men call it that—it's a falls of liquid ammonia that spouts right out of the face of a cliff. They can't imagine its source. According to all logic—they measure the force of the falling liquid and can tell the height it falls from—it should originate about five miles up.

"Some explorers went up that high once, and with special instruments they

followed the Fountain in its course through the mountain. Five miles up—which is about the highest a mountain ever gets on Jupiter, due to the gravity—they lost track of it. And they didn't find the source. They found that, due to conditions of atmospheric pressure and heat up there, ammonia gas would not condense to liquid. So how could there possibly be a source for the Fountain up that high? Well, it's still a mystery. And there are those funny hills to the south of Jupiter City, Colbie, that are made of the hardest——"

He paused. "Not boring you?"

"Go ahead and talk," invited Colbie. "But it's queer to hear you sentimentalizing about the comforts of home."

But Deverel lay still, saying nothing more. Apparently he had said all he wanted to.

After a while, Colbie stretched out beside him. He felt apathetic. He was not bothered so much about their fate, now that he was quite certain what it was to be. For a while they would live and then they would die. There seemed no other course to follow. Dimly, in his moment of sleepiness, he remembered that time within Vulcan when he had allowed this outlaw beside him all the latitude he wished, because he had been so sure their cause was hopeless. And Deverel had escaped him. But, of course, *this* was different. There really was no way out this time. So he slept—for he was tired. And when he awoke, Deverel was gone.

V.

HE SEARCHED the island, throwing light into every spot of darkness wherein the outlaw might have secreted himself. He managed to scale the spire that rose unflawed almost in the center of the island; but it was a gesture that indicated his absolute bewilderment.

His bewilderment gave place to a blazing anger directed against himself. Once more Deverel had utilized his remarkable energies of the mind and had escaped the law; once more Colbie had played the fool.

But cursing his own stupidity was no way to solve the questions paramount in his mind.

Where had Deverel gone? What flight of logic had told him there was a place to go to?

Colbie sat down and tried to think it out.

There were these facts to go on: He was on an island about seventy feet in diameter, just about in the center of a lake at least two hundred feet in diameter. The lake was girded by unscaleable walls.

It rained continuously; ammonia rain, it was, that fell without stopping, that came down in torrents, and with considerable force—an eternal downpour. Did that mean anything? Was there any clue there? Thus his thoughts ran, and suddenly something clicked. Did it mean anything? Certainly it did! Why didn't the lake rise? Why didn't it come up and overrun the island? There wasn't any visible outlet; therefore there must be an invisible one!

He stiffened in exultation. That was how Deverel had gained egress from this trap! But, he thought more soberly, if that outlet were subterranean, as it must be, then it would almost positively lead to a point miles below the surface of Jupiter! Why, that was worse than the present predicament!

Deverel must have been crazy, he thought. No, he thought again, Deverel was *not* crazy; he was cunning, and he was the kind of a man who would take a chance when the odds were against him. What then, was the chance which Colbie was overlooking?

He couldn't solve the problem.

He began to think about that singularly queer soliloquy the outlaw had indulged in, and the more he thought about it the more he was convinced that

the outlaw had said it with a purpose—perhaps to give Colbie a hint as to where he had gone.

He had laid particular emphasis upon a Jovian phenomenon called, by man, the Fountain. Was it possible that this lake was the Fountain's source? Irritably, he decided it couldn't be. Men of science had proved that the Fountain originated five miles up in the mountains, and that the condensation of liquid ammonia would not take place that high.

So Colbie had to reject the Fountain—almost. He stubbornly believed that Deverel had alluded to the Fountain with a possible solution in mind.

So Colbie arose from his reclining position, walked down to the lake's edge, where he stood looking at the water-clear liquid. He hesitated for but a moment, then walked into the lake.

ITS BED sloped down swiftly; Colbie reasoned it must be pretty deep. He walked forward with a steady, unfaltering pace. It came up to his knees, to his hips, to his shoulders. It was then he hesitated again, shivering in chill apprehension. It was the idea of going down into the depths of the unknown that made him almost sick with fear. But he kept on walking, and when the constant bombardment of rain ceased, he knew that his head was beneath the surface.

He took another step forward. His foot touched nothing. He strove to regain his balance, but he fell downward slowly. He could not stay himself. But his fears were unfounded, for he landed on a solid surface, and struggled to his feet. Frantically, he switched on the search beam built into the breast of his suit, though he had wished to conserve his power for later emergencies. The swiftly dimming path of light did little, however, to relieve that abysmal fear of the unknown.

He came to the wall of the lake, noted that it continued in unabated austerity of contour down to the lake's floor. He followed it, one hand scraping it to help him keep his balance.

The lake was quiet, but there was a slight current. Knowledge of where this current must lead made his nerves crawl, but at least there was the comforting assurance that where he went, there was Deverel. Much good it was going to do him.

The current was becoming stronger. He felt as if the flat of a giant hand were urgently pushing him along. He tried to hold back, then, in panic, realized that he couldn't.

So he abandoned himself to the push of the current. He cooled down abruptly. There was no use fighting the unpreventable.

Then he was swept off balance. He began to spin. The liquid about him began to boil violently. He was swept to the right, breath-takingly, and it seemed as if he could hear the liquid humming past him, so swift became his passage. With what little latitude of thought his dizzy brain gave him, he reasoned that he was now in the outlet, a tunnel through the escarpment, probably.

For a few seconds his course was straight. He did not have the optimism to believe it would continue in that manner. Of course, it was bound to make a downward turn. He knew that well enough, and waited for it, waited for that sickening drop down into the bowels of the planet.

But, seemingly, the rigid laws of logic and physics were not adhered to on the crazy planet Jupiter, for the current did not turn down. It turned *up*.

Dumfounded, Colbie found himself too dazed to hunt for the solution. He didn't think there was a solution. Why, that stream simply *couldn't* turn up!

But it had.

AFTER A WHILE he found himself unable to think clearly anyway. In the long hour of that vertiginous ascent, he

was battered repeatedly against the walls of the passage, and though the Jupiter suit, true to its legendary invulnerability, was not affected, Colbie felt the shocks in every bone and muscle in his body.

Turning over and over, on a cock-eyed merry-go-round, he found himself unable to correlate his thought processes with the things that were happening to him. He had not the least idea where he was going, but he wished with all his heart that he would get there.

Abruptly, he was no longer ascending. He was coasting along on a straight course. Somewhere below lay the lake—miles below, it must be. Incredible little lake it was, sending its surplus content into an outlet which went upward, defying the very law of gravitation!

He had risen at a thirty-degree angle, and now he began to drop at even a greater angle, and thus a little faster. Then a great light dawned in him, and he thought he had grasped the truth. But it slipped away from him, even as consciousness slipped away.

He had been losing consciousness gradually. The merciless batterings against the sides of passage were beginning to tell. The last thing he remembered was placing his gravity control at about Earth normal. He was falling, falling fast, and he didn't want to hit too hard. Then the darkness of the tunnel seeped into his mind. He was quite unaware of the remainder of the descent and——

VI.

ABRUPTLY, he was conscious of two things: first, a steady, throbbing, rushing, roaring sound that stole into his body and seemed to dominate its pulse beat; second, a strong light that was directed squarely onto his face. He tried to look beyond the beam, but couldn't. Anyway, he knew who it was.

"Feeling better?" Dewerd asked, and, when Colbie made an attempt to get to his feet, added, "Stay where you are for a while."

He had a projector in his hand—the deadly hand weapon of the twenty-third century. He had spoken slowly. Gloom was all around them. The beam itself had to pierce swirling, chaotically colored vapors.

"I knew you'd come along," said the outlaw.

"Did you?"

"Yes. I knew you'd figure it out far enough to enable you to follow me. Of course, I was only acting on guesswork myself. I was not sure I'd turn up safe."

"We're safe?"

"As can be. That's the Fountain you hear—all that rushing and roaring. Falls about a hundred feet from the face of the cliff behind you into a deep lake. I fished you out of the lake. You were floating. You had sense enough to decrease your gravity potential, probably for the same reason I did.

"Now you wonder why I went away without taking you. As I said before, I knew you'd follow. I dropped those hints about the Fountain for that purpose. If I had taken you with me, Colbie, I knew the confusion of it all would give you the chance to get the upper hand again. As it is, you see, I've got the upper hand. I took your projector," he added with humor.

Colbie groaned dismally to himself. Until now he hadn't realized it was gone. "Now what?" he inquired bitterly.

"I want your credentials."

"What?"

"They'll give me immunity in Jupiter City, Colbie. I can get a ship from the garrison. I can escape some place—never mind where, busybody. Give me your credentials."

"If you can get them," snarled Colbie, thrusting out his jaw angrily.

"If you don't give them to me, I'll kill you and take them."

Colbie opened one of the pocket drawers of the Jupiter suit and drew out a long metal tube. He gave it to Deverel, then eyed him questioningly.

"I'm going to Jupiter City," answered the outlaw. "You can follow me—after a while. I sort of like you, lieutenant, and I couldn't shoot you down in cold blood. By the way, I suppose you've solved the enigma of the Fountain?"

Colbie nodded his head in affirmation.

Deverel said, "Not so mysterious now, is it? Simple, in fact. I thought of the possibility when I went beneath the lake; but I was only acting on guesswork.

"It's possible, Colbie, that you had forgotten the enormous atmospheric pressure on Jupiter, a pressure which would have thwarted man's settlement of the planet had it not been for the discovery of the alloy from which Jupiter suits are made. That pressure is in the order of thousands and thousands of pounds to the square inch; it could raise a liquid to the height of five miles. If you had thought of that pressure, possibly you would also have considered the possibility of a siphon.

"You know the prime requisite of a siphon—that the liquid to be drained away must lie above the point to which it is drained. Well, the source of the Fountain, the lake where we thought we were hopelessly trapped, lies above the mouth of its outlet, the Fountain."

DEVEREL was talking slowly, in a monotone, perhaps merely to hear his own voice in this solitude of murmuring gases that whirlpooled ceaselessly around.

"Take the ordinary siphoning tube—liquid is rising in the short arm, descending in the long. It is atmospheric pressure and gravitation that makes it possible. Take the ascending part of the hose—the liquid in it weighs less than the liquid in the descending part. All right, the liquid in the descending part falls—gravitation. It has a tendency to produce a vacuum in the hose—right where the siphon turns down at the top. Nature, as you have doubtless heard, abhors a vacuum. Air always tries to fill this vacuum; but in this case it can't get in. Naturally, the air transmits its pressure—atmospheric pressure—to the liquid, and the liquid goes up, preventing such a catastrophic occurrence as a vacuum.

"In this case, the liquid was ammonia; the siphoning tube was a tunnel through the mountains; and the outlet was the so-called Fountain. There you have all the requisites for a siphon—perfect."

Colbie had listened patiently; he knew well enough the principle of the siphon. He grinned wryly to himself. He had known the principle of the siphon so well that he remembered only that water, under atmospheric pressure, will rise thirty-three feet; but that had been on Earth, and never for a moment had he considered that Jupiter's immense atmospheric pressure was capable of raising a liquid of the order of density of water to a height a thousand times and more as great. Deverel, of course, had considered it!

But Colbie was able to pick the obvious flaw, or apparent flaw. "But," he pointed out, "the tunnel had to be filled before siphoning operations could start; otherwise there would be no tendency to a vacuum."

Deverel was thoughtfully silent for a moment. "That's a good point, but I don't think man will ever know the answer. All he can do is theorize. Theorizing, I'd say that once upon a time, a long time ago, the lake was far up in mountain region, and the tunnel was just a plain everyday subterranean outlet, ending at the Fountain.

"Then the whole mountain range buckled under the stress of weight distribution; the lake dropped; the tunnel

was bent into the form of a siphoning tube. It wasn't choked up, so the liquid—it might have been, up that high, some other liquid gas than ammonia—kept on flowing." He nodded in satisfaction. "That's probably the answer, at that."

HE WAS SILENT. Murky gases danced fantastically through the beam of light.

Colbie lay on the strangely spongy soil, held there by the threat of the outlaw's weapon. He said, "We're using up oxygen."

Deverel snapped, "How long can you breathe on what you've got?"

"Thirty-six hours," answered Colbie, after inspecting the gauge.

Deverel growled to himself, "It's foolish things like this that are going to put me behind bars! Well, you can get to Jupiter City in about twelve hours. But I want you to stay here the other twenty-four."

Colbie's eyes widened in surprise. He started to say something and stopped. "I see," he said, looking at the leveled weapon. He met Deverel's eyes and said solemnly, "You have my word of honor that I won't move any nearer Jupiter City than I am at present for twenty-four hours."

Deverel dropped the beam from Colbie's face and turned it on his own. He smiled in a friendly fashion. "All right, lieutenant," he said softly. "You're a good fellow—I hope the feeling is mutual. Well, good-by! I'll try to keep out of your way hereafter—for both our sakes I wish you would do the same!"

He turned quickly in the direction of Jupiter City. The search beam built into the breast of his Jupiter suit turned with him, and almost immediately, save for the faint glow of reflection from the thick gases that raced across the surface of the planet, he was lost to sight.

Colbie lay back on the ground, because his body was still an inferno of aches and pains. Bitterly, he began his twenty-four-hour wait; bitterly, because he resented his helplessness. Deverel wouldn't have much trouble getting a ship, and then there'd be the whole solar system that Colbie would have to go over as with a comb.

He reflected that Deverel's escape was not his fault so much as he had believed. Natural phenomena had a way of helping Deverel and forgetting him entirely.

Smallpox of Space

by JOHN W. CAMPBELL, Jr.

THE early astronomers had no conception of the complexity of the solar system; perhaps, if they had, the science would never have started. The problems would have appalled them. Normally, we think of the solar system as being composed of the Sun, around which encircle nine large planets, a few small ones, and a few odd moons, making a total of—oh, thirty members or so.

The total number of individual units composing the solar system, each unit following its own orbit under the influence of solar and planetary gravities, certainly exceeds 100,000,000,000. Astronomers *must* consider the effects of all those units. Roughly, the divisions are: 1 sun; 9 planets; 26 moons belonging to 6 planets (discovered to date; Neptune and Uranus probably have more); 3,000, or so, planetoids; 1,000, or more, comets; meteors to make the balance.

So far we have considered the arithmetic of the solar system; it has gone in nice, big, round units: 1, 2, 3, 4—9. Arithmetic properly deals with units; now comes the calculus of the system, the mathematics of the infinitesimal.

Of what importance are these infinitesimals, these 30,000 asteroids and planetoids? Calculus depends on multiplying the infinitely minute by infinity; the answer then can be any quantity. No matter how small the quantity, multiplied by something equal almost to infinity, it becomes staggeringly huge.

Consider the problem from this angle. Mathematicians and astronomers since the day of Newton have struggled with the famous problem of 3 bodies; most laymen consider that problem a sort of higher brain teaser, an interestingly difficult trick problem on which mathematicians may spend idle hours. Basically, the problem requires that mathematical formulas be developed such as to describe, fully and completely, the motions of three gravitating bodies. When solved it would permit the astronomer to substitute into standard formulas the quantities representing the masses of the bodies, their distances apart, and their velocities. By certain, specified manipulations the equations could then be solved to find their positions and velocities at any future time, however remote. Its solution, perhaps, seems merely interesting, but not vitally important, since we can solve the problem of 2 bodies, predict the positions and velocities of two gravitating bodies, by the laws originally worked out by Newton.

Actually, the problem of 2 bodies is an unreal fiction, of no practical importance in itself. *Nowhere in the solar system does any such problem come up.* This is the problem of purely theoretical interest, the toy for mathematicians, because it has no actual parallel in the system. *That*, not the problem of 3 bodies is the impractical theory.

To fully express the motions of three gravitating bodies is the closest of all astronomical problems. The Earth-Moon-Sun trio constitute exactly such a system, and as Charles Fort pointed out in *Lo*, astronomers cannot accurately determine the time or place of occurrence of a total, solar eclipse. Neither can the tides be exactly forecasted, nor will they be till the 3 bodies can be solved.

Article No. 15 in a study of the Solar System

The oldest theory of the origin of the planetoids is the suspicion that they may represent the remains of an exploded primal planet.

The immense importance of the problem of 2 bodies lies only in its ability to give approximate answers to the three bodies by considering them two at a time, two at a time, time and again, each time nibbling off a tiny bit more of the inevitable inaccuracy. At planetary distances, the Earth-Moon system can be considered one body, acting as a mass concentrated at the center of gravity of the two masses. Thus, until the real problem is solved, quite accurate approximations can be made. Actually, of course, the problem of the solar system

represents a problem of an almost infinite number of bodies. *We do not, and cannot know the fate of the system in the far future, because we cannot solve that problem.*

The 3 bodies can be solved; eventually it will be. Shortly after it was recognized, Lagrange developed some special solutions. That is, if the astronomer is allowed to pick and choose, and place his bodies where he wishes, solutions can be attained for these highly artificial arrangements. Lagrange's original solutions were of two types: in the first, the three bodies so moved as to always form a straight line. In the other, the three form an equilateral triangle, whatever their masses. Both of these systems are eternally stable. The most complete discussion of the problem yet developed is due to Poincare, who developed several other, more complex special solutions.

CURIOUSLY, there is in the solar system an almost perfect example of one of these seemingly impractical, trick solutions. It involves Jupiter, the Sun, and some interesting bodies never mentioned in science-fiction: the Trojan planets, some of the most curious worlds of the entire system. They are unique in this way, too; since they do represent one of the few, rare, solutions to the problem, they are, unlike the Earth-Moon system which will eventually crash, stable. The Trojan planets will wheel about the Sun in perfect stability for long aeons after the Moon has crashed to Earth, strange little worlds circling in orbits made rigid and secure by the influences of the mightiest masses of the solar system; the Sun itself, and giant Jupiter.

In a sense, the Trojan planets are members of the general class called planetoids or asteroids. The first of the planetoids was discovered on the first day of the first month of the first year of the nineteenth century, January 1, 1801. Piazzi, on that night, discovered Ceres*, and calculations developed by the German mathematician Gauss soon showed that it was in an orbit between Mars and Jupiter.

By 1807 Pallis, Juno and Vesta had been added to the list of planets in orbits between Mars and Jupiter. In 1845 another was discovered. Since 1847 they have discovered at least one every year. The thing had evidently gotten somewhat out of hand. One was all right, but at present about 1,200 planetoids are known, circling in and about that region, ranging in size from Ceres, the largest of them and only 485 miles in diameter, down to mere cosmic boulders 5 miles or so across, things not even round enough to merit the term diameter.

So out of hand did it get, in fact, that astronomers began to feel that there must be thousands, if not tens of thousands of worlds there. The best guess as to the total number at present seems to be about 30,000 of all sizes, shapes and types. At first, astronomers had thrilled to the new discoveries, but the sheer number soon become boring, and labor-saving devices were invented.

At present, asteroid discoveries are made by mass-production machinery. Two general methods are used, each based on the same idea. In the earlier method, a telescopic camera is mounted on a clockwork drive and adjusted so that it moves exactly fast enough to offset the Earth's rotation on its axis. The stars then appear to stand still. They form sharp, pin-point images on the exposed plate. The planetoids, however, are members of the solar system, and move relative to Earth; Earth's motion in its orbit shifts them across the background of stars. The finished plate, after hours of exposure, will show the rich, star-strewn background of points,

*A new metallic element was isolated in the year 1901, an element that has since found application in a number of minor things, including the making of cigarette-lighter "flints." Named in honor of the discovery of this planetoid, it is cerium.

marred by a few, short, stubby lines—smears produced by moving asteroids. Planetoids discovered by the dozen while you wait.

The second method is even more sensitive. Since all the asteroids are almost equally distant from Earth, revolving as they do in approximately equal orbits, they must all move in just about the same manner, shift across the plate at about the same rate. Fine.. Then move the plate by means of the clockwork at a rate such as to exactly offset the motion of the average planetoid. Now our plate will show the stars blurred and smeared by motion, while the asteroids will appear as nice, clean points, in general, with only a tiny bit of blurring in one direction or the other, dependent on whether one was a bit nearer or more distant than the average. The advantage is that all the light reaching the plate from one tiny asteroid builds up, hour after hour, on one small point of the plate, and bodies so dim as to be unable to mark the plate when shoved across, leave a firm impression. This method, however, may miss asteroids in highly eccentric orbits at such distances as to make them move almost as slowly as the stars.

THIS WORK is done largely by amateurs, but what amateurs! To find a new planetoid means that you must first show that it is not an old one. Almost 1,200 are known and recorded. If the amateur suspects he has discovered a new one, he must determine its orbit, then compare it with known orbits, and thus show that it is not an old one. They have simplified orbital calculations to the utmost, but it remains inevitably a mathematical problem not to be lightly undertaken by grammar-school arithmeticians. Further, the orbits cannot be determined just more or less, roughly, because of the immense complexity and the close parallelism of those already known.

If the asteroid system were modeled, each body and its orbit being shown by a bead on a loop of wire, it would be impossible to remove one of the intertwining, interwoven, tangled orbits without pulling out almost all the rest. The model would resemble a steel-wool scouring pad.

Some of the planetoids follow orbits almost exactly circular, some have orbits so elliptical and elongated they actually are more eccentric than those of many comets. Most of them lie almost exactly in the plane of the orbits of the large planets, some cut out at weird angles, as much as 30° out of the plane. Further, those that slant out at this angle usually have very eccentric orbits as well. The orbits are neither concentric nor evenly spaced. Although most of them lie always between Mars and Jupiter, some cross over to distances less than that of Mars, one, at least, approaching nearer the Sun than does Earth. On the other hand, many loop out far beyond Jupiter, one, again, going on out to the depths of space beyond Saturn.

The orbits are not by any means evenly distributed, and, furthermore, there are sharp and definite breaks; concentric rings about the Sun where no asteroid can have its orbit, just as there are breaks in the rings of Saturn, and for a similar reason. At any given distance from the Sun, a fixed orbital period is required for stability, the period being determined rigidly by the characteristics of solar gravity.

At those distances which require an orbital period of 5.94 years, 3.95 years or 8.795 years there are no planetoids. If there were—they would be in phase with the orbit of Jupiter; periodically the enormous mass of the Jovian System would lay violent strains on them, twisting their orbits aside viciously, for Jupiter's period is twice 5.94 years, three times 3.95 years, and 4/3 of 8.795 years; commensurable periods cannot be stable.

In this action, not only the mass of Jupiter would act, but the combined mass of 5 worlds, each planetary size in its own right: Jupiter, Io, Europa, Ganymede and Callisto. This enormous mass combines to act as a mighty whip to force every body in the solar system to avoid synchronization. Saturn itself would not dare to approach close synchronization with that overwhelming mass.

The asteroids themselves vary as widely as their orbits, in size, character and every other particular. Only the largest have been investigated as individuals: Ceres, 485 miles in diameter; Pallas, 304 miles; Vesta, 243 miles; and Juno, 118 miles through. The reflecting power of the surfaces are our only clue to their nature, for, being so small, they have very little mass, and hence no noticeable perturbing power.

The mass of Venus can be deduced from the way it affects Mercury and Earth; the mass of Mars can be accurately determined from the motions of its satellites. Ceres and the other planetoids are too small for perturbation work, and although they may well have satellites in a region so richly populated with small bodies moving at almost the same speed, we cannot detect any. Since they are so small it is practically certain that they have no atmospheres; the light reflected from them does not pass through a gaseous medium other than Earth's own atmosphere, and hence the spectroscope is useless. A mirror can show equally well the spectrum of a sodium flame or that of the Sun, but in neither case does the reflected light say much of the mirror's composition.

HOWEVER, the reflection intensity, the "albedo" does indicate some things of interest. Ceres reflects light to about the same degree as does our Moon. From that we might reasonably deduce that, like the moon, its surface was a cragged, mountainous region of colossal heights and fearsome gorges, with great plains limited by sharp-dropping horizons. They are, no doubt, scarred by the millions of meteors that have pounded into its unweathered surface. Juno is a bit more reflective than Mars, Pallas about equally. Their surfaces may be made up of less-cragged rocks, or perhaps a coating of rock dust, broken by the spalling action of sudden, furious blasts of solar heat alternating with interplanetary cold.

But Vesta is as reflective as the silvery, cloud-wrapped surface of Venus or Jupiter! It is impossible that so tiny a body has either atmosphere or cloud; even ice would be impossible in space, for ice has a low, but distinct vapor pressure, and during the aeons would dissipate into space. Nothing more volatile than mercury metal (it throws off distinct traces of vapor, which become visible when viewed under a mercury-vapor arc light) could survive astronomic time on Vesta. Yet its reflective power equals that of the planets wrapped with the most dense and cloud-filled atmosphere. What the solution is we do not know. A guess might suggest that it was composed largely of quartz crystals, or masses of white rock such as calcium sulphate, or aluminium oxides.

The oldest theory of the origin of the planetoids is the suspicion that they may represent the remains of an exploded primal planet, whose parts, though blasted by some colossal violence, still follow the ancient orbit. If so, then all the orbits should cross at one point, were it not that during the ages Jupiter's attraction, the cross haul and tug of Saturn and Mars, have served to distort those orbits beyond recognition. However, certain other properties of the orbits would remain forever, sufficiently stable to show, even to-day, that they had once started from a common point.

Laborious investigation has been undertaken, and this has shown that the

orbits cross—some few of them. But not in one point—in several, as a matter of fact. There are families of planetoids that had a common origin somewhere in space, but not *our* common origin—many. And there is one property that throws even graver doubt on this question. Many of the asteroids rotate on their axes, and the direction of this rotation can be determined in those cases (which are numerous) where there is one bright spot, or a brighter side of the planetoid. All those investigated rotate in the same direction, in the direction that all the planets and nearly all the satellites rotate, in the same direction that those bodies created in the original creation turn. Would the flying fragments of a broken planet rotate all in the same direction?

Let us return for a moment to the effects of Jupiter's mass on the planetoid orbits. He would, evidently, make an orbit of half his period unstable, one of 2/3, or 3/4. Bodies in such orbits would be driven outward, or forced inward. Saturn, too, would have a lesser effect, stirring and wavering the orbits. Forced back and forth, changing and shifting, the harassed planetoids would seem some measure of stability, an orbit that would not be disturbed in any way, incommeasurable with all perturbing bodies.

But, there is one, and only one: Jupiter's own orbit. Nothing dares to get in step with that mighty mass. Unless it gets *exactly* in step, for Jupiter cannot perturb a body rotating in its own orbit, at exactly the same rate, so that it never comes nearer or gets farther away from the planet. Remember that one of the special solutions requires that the three bodies, whatever their mass, form the vertices of an equilateral triangle. The Sun is one mass, Jupiter the second—and, of course, to be an equal distance from the Sun, the third point must lie in Jupiter's orbit. Further, there are 2 possible points in that orbit, one a distance ahead of Jupiter equal to the distance from Jupiter to the Sun, one an equal distance behind.

The Trojan planets illustrate this solution neatly; 5 of these bodies oscillate about the point ahead of Jupiter, and 4 about the second point behind him. Their orbit is perfectly stable, it being one of the 3-body solutions, and defended by the combined masses of Jupiter and his 4, planet-sized satellites. Probably once planetoids were harassed and whipped about by the cross tugs of planetary reactions; they were driven out, till, at last, they found the most stable situations in the entire solar system; the 3-body solution involving the 2 greatest masses of the system: Jupiter and the Sun itself.

WHAT VALUE can the asteroids have to man? When space travel is established, the asteroids will be useless, but their economic importance will, unfortunately, be undeniable. They will, so to speak, rate with disease: valueless things that cause all sorts of trouble.

First, the only use that has been proposed for them involves mining them for precious metals, or hauling them off bodily for their content of nickel iron. There is no doubt that they do, many of them, consist of pure masses of nickel-steel armor piercing projectiles. That inextricable tangle of orbits makes it impossible to work with even reasonable safety among them; were they all revolving in neat, concentric orbits, the danger of collision would be small, because the space ship bent on mining could match the speed of the local asteroid field, and so be in no danger of high-velocity collisions. The asteroids are the anarchists of the system; they don't behave that way; all those looped, eccentric orbits would come crashing through at high velocity, making it impossible to match the speed of all those in the neighborhood.

Furthermore, in discussing interplanetary dividends it was pointed out that Pittsburgh could compete successfully with pure, free iron on the surface of the Moon. If free iron could not pay its way from the Moon, it certainly has no chance of paying its way from the deadly asteroid belt. Asteroid mining is not likely to pay very early in space travel, that is certain. Imagine the danger of prospecting, and developing. Living on Ceres, for instance, would be like establishing a mining camp in No Man's Land during the Battle of the Somme.

Most of that cosmic scrap, such as meteors and, probably, the asteroids, contains platinum, silver and other precious metals. Perhaps they would pay for the work. The man who attempts that must treat the nickel-steel alloy containing the platinum solely as a peculiar kind of platinum ore. And, man, it's a honey! You can't crush it. Only the toughest tools will cut it up. It's a notoriously stubborn alloy (armor plate) and it is dense, heavy stuff. Before separation can be affected, it must be dissolved in acid, or some similar reagent.

The iron and nickel, at any rate, are merely annoyances, not secondary sources of profit. The best illustration of that trouble is on our own Earth: Monel metal. That is an alloy of copper and nickel. The nickel ores contain definite, recoverable amounts of platinum, iridium, gold, silver, and a host of other precious metals. However, so does the finished Monel metal. It doesn't pay to go to the trouble of extracting them.

And no one can doubt that the asteroids promise to be the space pilot's nightmare. That they will for a moment consider battering *through* the asteroid belt is insane; naturally, they will dodge it by the simple process of going north or south* out of the plane of the ecliptic, and dodging over the belt before returning to the plane. But since some of the asteroids follow orbits inclined more than 30° to the plane, that dodge will be a detour of hundreds of millions of miles, and days of travel. And a nice, judicial balance between "How close to the plane can I go without getting ruined?" and "How many days is this blasted detour going to take?"

No, nobody is likely to become fond of these smallpox of space.

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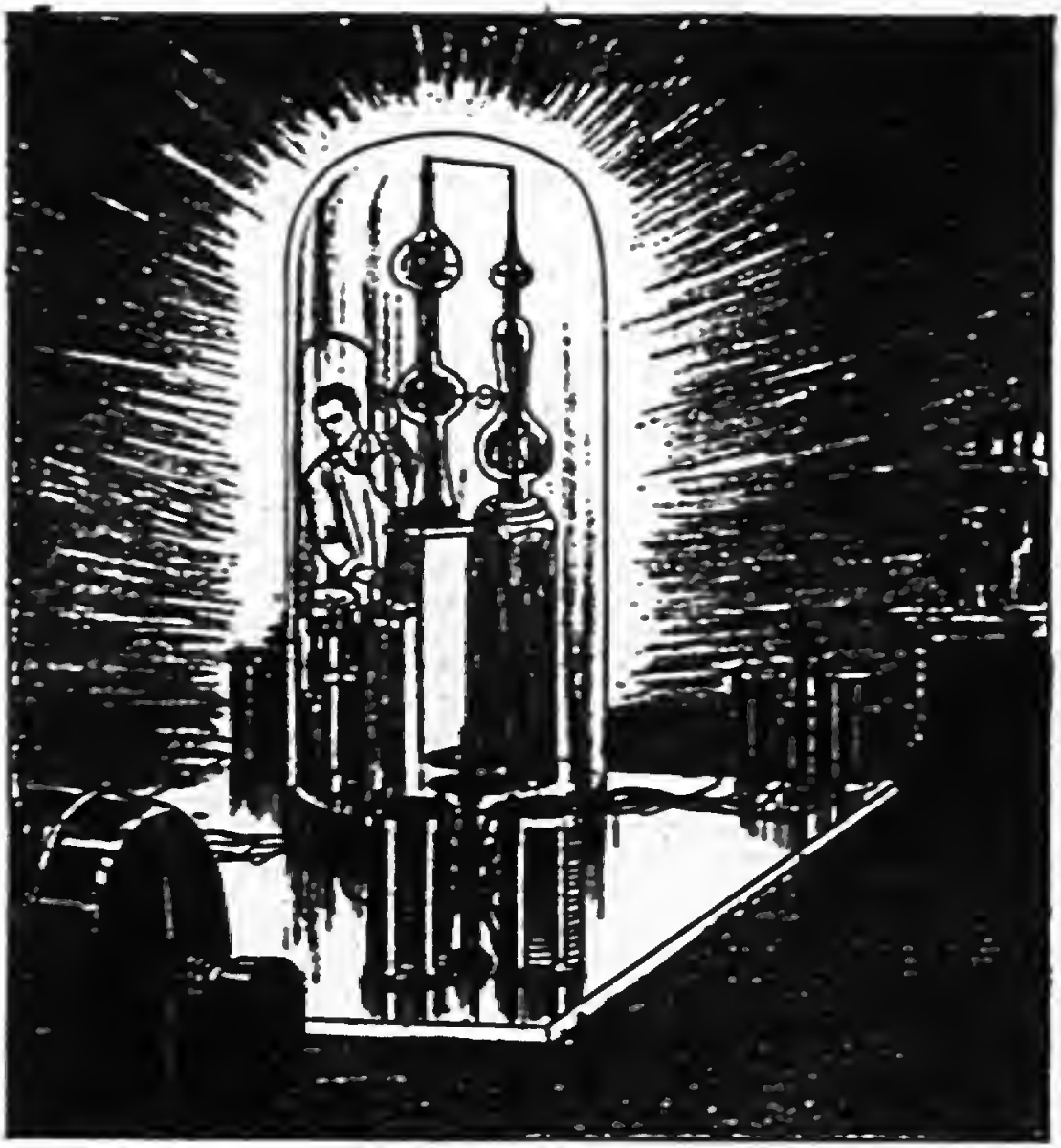
* North and south have meaning in this sense, since one end of the Earth's axis is north of the plane of its orbit, and the other south. Hence we can legitimately speak of going north of the plane of the ecliptic.



The Time Bender

by Oliver Saari

WIPING tiny beads of perspiration from his forehead, Cameron stepped back and viewed his machine, smiling in his quiet way.

A thick platform of brilliant metal was imbedded in the concrete floor of the laboratory. On it rested a cylinder of heavy glass, domed at the top, ten feet high and five feet in diameter, containing a mass of scientific apparatus. The most noticeable part was a cube of black metal at the base of the cylinder, seemingly in contact with the platform on which the machine was standing. Four compact units of machinery

flanked the cube, connected to it, and to each other, by a network of tiny wires. No parts which might move or rotate were visible; the machine utilized forces greater by far than those applied through cogs and wheels.

With this, the product of many years' labor, Cameron was about to conquer the realm of time! With steps that were eager, yet a bit fearfully, he approached his creation. He had but to adjust a finely graduated dial to project himself and the machine ahead in time—a year, five years, a hundred, or a million—there was no limit save his own imagination. On his trial flight he planned to travel to the year 3000.

The principle of the Time Traveler hinged about Cameron's discovery of neutronium, the perfect substance, made by draining the energy of atoms. An atom of ordinary matter is composed of negative and positive charges of electricity—electrons and positrons—the energies of the two balancing each other. Both are particles of pure energy, with practically no mass. Mass is given to matter by the neutron, a heavy, inert particle that is found in the nucleus of the atom, one with each positron.

Cameron had found a means of removing all the energy of the electrons and positrons, leaving an incredibly dense residue of neutronium, held in a tremendously rigid state by the gravitational attraction of its component particles for each other. He had released atomic energy, of course, in draining the energy from the atoms, but he treated that as a mere side product; his goal had been neutronium. Absolutely inactive chemically, reflecting all known radiations, the "metal" possessed properties even Cameron, its creator, could scarcely comprehend.

Relativists have suggested that around the heavier stars time progresses at a slower rate, because the immense masses warp both space and time. Cameron had invented neutronium with this in mind. Though the total mass of the neutronium plate was negligible, it was so highly concentrated that near it was produced an almost visible space-time warp. Light rays passing above it were refracted because their time rate—and therefore their speed—had been changed momentarily.

Just as a body in space cannot move unless it has something to push against, so a body cannot travel in time—change its time rate—unless it has a foothold on that medium. The time warp produced by neutronium was the foothold; traveling along and against it, the Time Traveler could move forward in time! It could not travel into the past, for the neutronium plate had to exist in all the ages traveled, and it had not existed before Cameron had made it.

Of course, the scientist had kept his discoveries secret; time travel and atomic power were too great to be let loose upon the world of 1942. A scion of wealthy and indulgent parents, he had been able to devote all his time and a considerable sum of money for developing his ideas. The project of conquering time would have been too great a task for any other mortal, but Cameron's brand of inventive genius, which may come but once in the history of the human race, had enabled him to come within sight of success.

Opening a section in the side of the glass, he stepped into the cylinder. With difficulty, he steadied his trembling fingers and grasped the little knob that was to start the machine moving along the time warp. He turned a dial, checking the reading carefully, then depressed the fateful switch.

A spectator, entering upon the tableau at that moment, would have seen a weird blue glow of electricity, heard a piercing whine, and seen the cylinder, with a bent, white-smocked figure inside, swiftly fade and vanish. A wave of air, rushing to fill the suddenly-

formed vacuum, would have propelled him toward an empty platform of silvery metal.

Cameron's machine had altered its time rate. It was still in the same spot, but it was invisible and intangible, as it would have been in another dimension.

Within the Time Traveler, Cameron reeled from a wave of nausea that enveloped him. Through the glass walls of the cylinder he saw the laboratory's electric-light bulbs suddenly turn blue, then violet, finally disappearing altogether, displaced by an abysmal blackness. To his senses the world outside had speeded up, and ordinary light rays from it, striking his eyes, were changed to frequencies too great to be visible. Soon the rays would change from ultraviolet to X rays, finally to cosmics—but there was no danger; they were not sufficiently powerful to do harm. Besides, he was in a different part of the time dimension and doubted whether anything from the outside world could have affected him.

One exultant thought beat at his brain: the machine had worked! He was traveling in time!

IN THE basement level of Chicago, under that mile-high structure of steel and glass, Valthor worked incessantly. The object of his labors, a transparent cellosheen cube seven feet on an edge, was slowly nearing completion under the twenty-sixth century scientist's nimble hands.

There was an indefinable air of great age about the laboratory, caused perhaps, by the seamed and cracked appearance of the concrete floor. In the middle was imbedded a round platform of brilliant metal, about six feet in diameter. The history of that object was strange indeed.

Some one in the latter part of the twentieth century had discovered the platform, which had been located in an abandoned laboratory belonging to one Cameron, who had disappeared. The thing rested on a reenforced concrete base that went down to the solid rock of the earth's crust. During the centuries it had lain there, never changing. Scientists had tried to analyze the strange substance, only to find that it resisted their best efforts. They could not make it combine with any substance; heat had no effect upon it; they could neither raise nor decrease its temperature! They knew it was very dense, but they could not find its specific gravity, being unable to cut the slightest piece off it, or even scratch it, with their tools.

Valthor had stumbled upon one of its peculiar properties quite by accident. He had found that the strange substance warped time to a noticeable degree! He had noticed the refraction of light passing over it, and, by successive experiments, had proved that this refraction could be due to no other cause than a considerable space-time warp. And now, on December 27, 2568, he was about to utilize it as a means of propelling a machine backward through time! His time machine, the cellosheen cube, was at last completed.

Valthor's aim was to solve a mystery that had always intrigued him: the mystery of the great Chicago explosion of 2253. On June 14th of that year, at three o'clock in the morning, the city had been awakened by a mighty explosion that had occurred in the middle of it, breaking nearly every plate of glass within miles.

It had not been an earthquake, merely one unheralded explosion that had shattered the eardrums of many who escaped with their lives. Of course the cry of "War!" had sprung up, but there had been no enemy to fight—none who could have committed the wanton act of destruction. Three hundred years had elapsed since that date; yet the cause of the explosion had never

been discovered. It remained one of the greatest unsolved mysteries of the world.

It was Valthor's plan to travel backward in time to June 13, 2253, the day before the explosion, and attempt to discover the reason for the disaster. The medium of time travel—the mysterious metal plate—had existed long before the explosion, and he could easily reach this date by following the time warp that had existed through the centuries. On arriving at the correct time, he would not have to scout far in his search, for his time traveler was located somewhere near the spot where the strange disaster had taken place.

The scientist had invited several of his colleagues to watch the beginning of his journey into time. After acknowledging the chorus of good wishes, he stepped into his machine and jerked the switch that was to send him hurtling back through the ages.

The years ticked off Valthor's dials with clocklike regularity. 2500—2423—2350—2300—— He tensed, waiting for the moment when the automatic control would stop the machine near noon, on June 13, 2253.

He could see nothing through the transparent walls of the cube, for he had completely reversed his time rate, and was invisible and intangible to the outside world.

The dial reached 2253; the finer meters crept backward through the months—December—August—June——

Cameron, of the twentieth century, was using the time warp to propel him ahead in time. Valthor of the twenty-sixth century was using the same warp of a later date to push his machine backward. Their paths intersected at the midpoint—at exactly 3:14 o'clock on the morning of June 14, 2253!

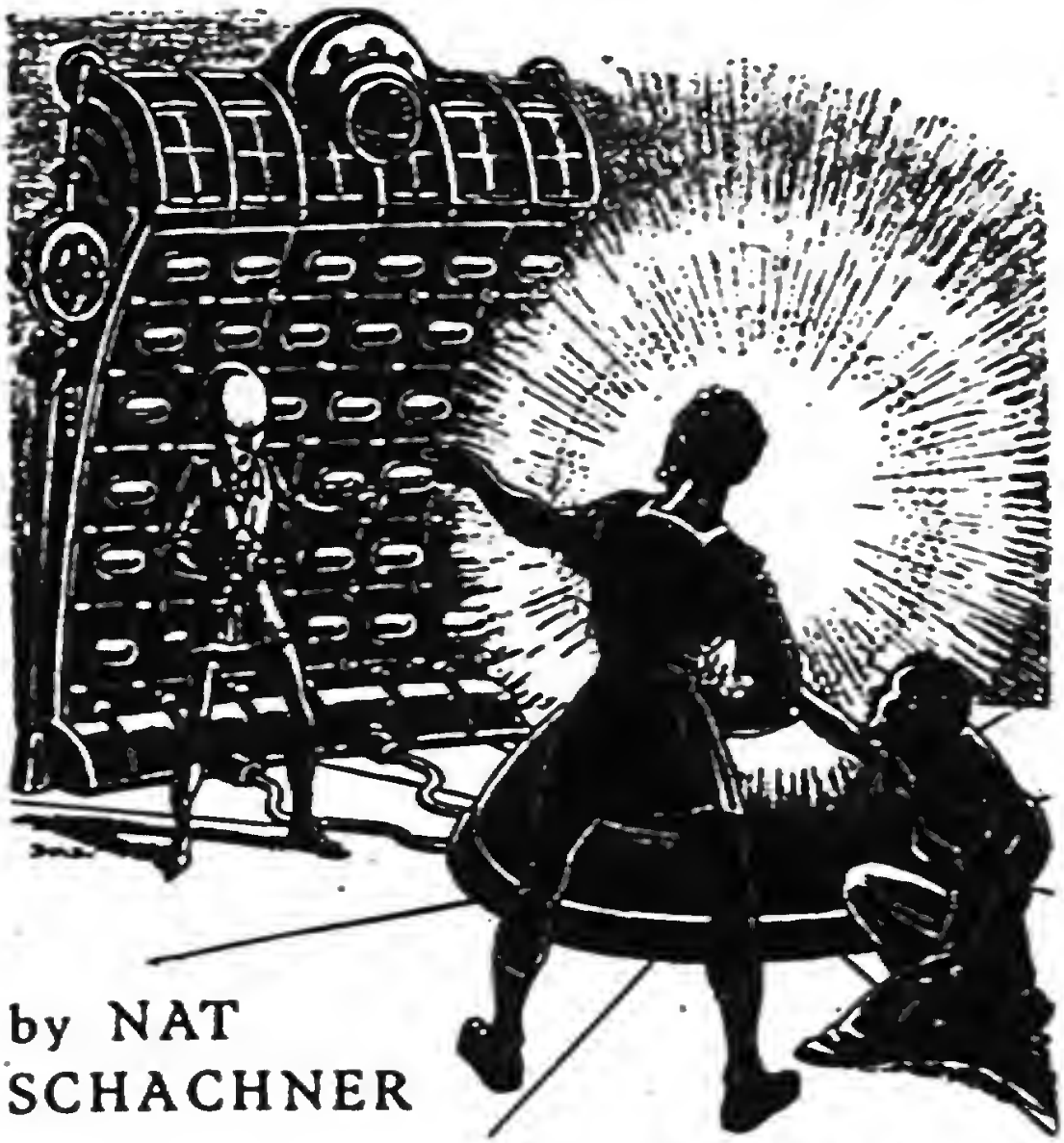
For one instant both machines were in the same space at the same time. The time warp bent under the momentary strain, and instantly they materialized above the platform, being thrown into a normal time rate by the collision. When a fundamental law of physics is violated, all the forces of the universe are exerted to make the offending matter conform. The time machines could not exist in the same space at the same time rate—yet they were so placed. Therefore they expanded—violently.

Valthor had found the cause of the Chicago explosion, but he was destined never to know it. And Cameron was never to reach his goal, the year 3000, for both he and Valthor had been converted into scattered atoms.

The great inertia of the neutronium plate saved it from being driven into its concrete base. The force of the explosion traveled upward and sideways. The plate lay there, buried under the wreckage, waiting patiently for a Valthor, who had not yet been born, but who had already died!

Crystallized Thought

A Science Novel



"Alive?" the Martian scorned. "Earthman, you are gazing at immortality—eternal power!"

by NAT SCHACHNER

WEBB FOSTER was the greatest scientist in all the solar system. This, at least, had been the consensus of opinion at the last assemblage of the planets. Webb, however, had protested the accolade and offered Ku-mer of Mars in nomination for the coveted honor. But Ku-mer received only two votes—his own and that of Webb Foster. Whereupon, with Martian blandness, he had retired from

the conclave and left an undisputed field to his generous rival.

Webb Foster was sincerely sorry for him. He knew the proud sensitivity of the Martians, beneath their outward armor of indifference, and he tried to find Ku-mer after the members of the quinquennial meeting had scattered to their respective space ships. But Ku-mer was not to be found. He had vanished.

Whereupon Webb, with a shrug of his shoulders, and slightly flattered withal, returned to his space laboratory. This was famous throughout the system, and the fruit of years of contriving. Webb Foster required absolute isolation and profound peace for his researches into the origin of all things, into the fine structure of space and time and matter. These desiderata could no longer be had on Earth, his native planet.

Earth was a vast garden city with a population of ten billion humans. From pole to pole swift-moving platforms made an intricate network of intercommunication: underground, express monocars whined through vacuum tunnels; overhead, glistening planes darted along aerial traffic lanes; while from a thousand rocket ports great space liners took off for Mars, Venus, the Moon, and far-off Callisto, capital of the Jovian hegemony. A scientist, brooding on the very fundamentals, the ground plan of the universe, could find no peace on Earth.

So Webb Foster had built his space laboratory. It took five years and the unremitting labor of a thousand men. But when it was finished, the planets marveled, and his fellow scientists ached with possessive longing.

It was a great crystal sphere, a thousand feet in diameter. The material was plani-glass, a transparent composition of Webb's invention. Its tensile strength was that of fine-wrought steel, but its lightness greater than that of aluminium. In its normal state it transmitted all the beating waves of space without let or hindrance; when polarized, however, only the wave lengths of light could slide along the latticed crystals. Neither electricity, magnetism, X rays nor cosmic rays could force their lethal energies through the impenetrable barrier. A special repulsor screen, such as the space ships used, diverted plunging meteors from their destructive paths.

Within the vast concavity Webb Foster set up his laboratory. All the normal apparatus was there: huge dynamos powered by solar radiation, giant electrostatic balls, flaring electron tubes high as a building, mass spectrographs, a powerful photo-electric mosaic telescope, delicate immersion baths.

But besides this regular equipment were machines that Webb himself had fashioned: infinitely sensitive wave traps that tapped subspace itself, positron segregators, where those flash-vanishing ephemera of nature could be held indefinitely; strange spiral whirligigs in whose light-approaching speeds time itself seemed to have lost its forward march—and a myriad other complexes of ultra-science.

Nor did Webb forget the more material bodily comforts. At the very center of his space laboratory he placed his living quarters, wherein he studied and ate and slept and had his controls, like an alert spider at the core of his web. In his storage compartments there was always a sufficient supply of dehydrated food for three years of wandering, a thousand-gallon tank of water, and air-purifying machines whereby the atmosphere could be indefinitely renewed and kept clean and wholesome.

WHEN the great globe was completed, and stocked with all its multitudinous machines, twenty rocket tugs towed it from its Earth hangar out into space, set it upon a previously calculated orbit a million miles beyond the Moon, gave it the necessary orbital impetus,

and set it free. Whereupon the space laboratory became a second satellite to Earth, revolving majestically around the parent globe in uninhibited gravitational flight, rotating slowly on its own axis to generate an artificial gravitational field within.

There, in the depths of space, flashing like a minor planet, the space laboratory went its way, using no power in its interminable orbit, granting to its master that isolation, that abstraction from mundane noise and crowding which no longer existed on any of the inhabited worlds. Yet, when he willed, a pulsing signal would bring a stubby, grimy cargo liner with the requisite supplies, or a space lock would open and eject a small, fast space cruiser piloted by himself. Nor was the great sphere itself devoid of directive motion. Jet-orifices studded its shining surface like crater pits, and sufficiently respectable speeds could be built up from the rocket-fuel tanks to take the giant laboratory even to the closer stars, if necessary.

Now Webb Foster returned with a sigh of relief. He jockeyed his tiny space cruiser into the silent lock, heard the convex panel hiss into position behind him, waited the required period until warmed air flooded the erstwhile vacuum inside, and stepped out eagerly. Already the conclave of the scientists was dismissed from his mind. Ku-mer's disappointment became a wavering mist. This was home—and there was much work still to be done, important researches temporarily interrupted by the meeting.

As the inner slide opened, a great face thrust itself suddenly into his own—a giant face, black as a starless night, grimacing with delight. A cavernous mouth yawned and a bull voice roared, "Welcome, master!"

Most Earthmen would have been taken aback and more than a little afraid of the monstrous apparition. But Webb looked up without surprise, and even considerable pleasure, at the giant, and answered cordially, "Hello, Stet! It's good to see your homely face again."

The giant grinned toothlessly. He towered over Webb a good three feet, and Webb himself was tall for an Earthman. Yet, though his bulk was ponderous, he moved with strange, catlike swiftness, and the muscles rippled over his ebon form.

He was a Titan, a member of the troglodyte race who inhabited that largest satellite of Saturn under conditions of cold and airlessness that would have proven fatal to any other people in the solar system. It was a savage, desolate world, from which the space voyagers usually veered away with cautious haste; a world liable to erupt these giant Titans from their unseen burrows to obliterate a venturesome expedition.

Yet Webb Foster had visited Titan in search of radio-active elements beyond the Earth tables, and found evanium, No. 95 in the list—and also Stet! Stet was engaged in a desperate losing battle with a horde of his fellow tribesmen. Webb discovered later he had violated one of the obscure taboos of the planet. A few well-placed bursts of penetron shells had scattered the howling savages to their burrows, and Stet, more dead than alive, was hauled incontinently into the space laboratory. Webb nursed the poor Titan back to health and found himself with a devoted servant, an unshakable, loyal dog on his hands. And he learned civilized methods with surprising rapidity, became exceedingly deft with the machines and a tower of superbly functioning strength to Webb in more ways than one.

The problem of a name bothered Webb for a while. The Titan's native appellation was altogether unpronounceable to an Earth-bound tongue. Finally, he called him Stet—a word culled from a long-dead language—because of his quality of standability, so to speak. If

Webb ordered him to hold a certain stasis, a certain given state of things until further orders, he had the comforting assurance that that situation, in Stet's hands, would partake of the timeless, would be abstracted from the general flux of normal events, until Webb gave countermanding orders.

WEBB let his eyes roam lovingly over the maze of apparatus—each machine stripped, lean, shining with hidden power; his nostrils twitched the pure artificial air like an ancient war horse snuffing battle. This was life; this was ecstasy. Already he was swinging down the slanting catwalk toward the central den, Stet lumbering behind. "Anything new?" he demanded over his shoulder.

The giant rolled his white-rimmed eyes. "Nothing, master." Then he screwed up his face. "That is—leastwise, Stet don't know. Been some funny flashes a-sparting from the Balto Dome, and they's been things fumbling round this old space lab."

Webb halted sharply. "What things?" he demanded.

The Titan scratched his shaggy pate. "Stet don't know," he confessed. "He saw jerky marks on the detector panel, heard signals in the amplificators——"

"Amplifiers, Stet!"

"Yes, master—amplificators. But Stet couldn't see nothing nowhere. Finally, the fumblings give up and go away."

Webb frowned, thought swiftly. Balto Dome was the chief mining area on the farther side of the Moon—that is, the side eternally turned from the Earth. The Moon had been colonized for five centuries. It was the treasure chest of an exhausted Earth, the rich storehouse of precious metals and chemicals which had long since vanished from the parent body. A fleet of cargo boats trafficked regularly between planet and satellite, laden one way with heavy ore and returning with food, clothing, machinery and the essentials of life.

The first colonists had built great domes on the Moon's surface, within which all operations took place, and ventured out on the airless surface only for exploration, clad in flexible space suits. In the beginning the Moon had housed scattered mining communities of men only—then women followed their men; families were born, and the amenities of life crept into the pioneering crudities of the domes. A century before, the Moon had taken on itself dominion status, with its own ruler and a compact of amicable association with Earth. The parent planet had consented.

Unexplained flashes from Balto Dome? Could there be trouble down there? Webb stared at the mosaic analyzer of the telescope. The Moon seemed normal, quiescent. But Balto Dome was invisible; it was already around the irregular terminator. Fumbling—unseen vibrations on the surface of his retreat? Impossible! His instruments were sufficiently sensitive to have picked up even the light emission of a single atom, once it penetrated his repulsor screens. Furthermore, not even a penetron shell could have forced its way through the field so as to impinge on the plani-glass, and upon the detectors.

"Stet!" he said suddenly. "You're sure you made no mistake?"

"Yes, master."

Webb shrugged his shoulders and forgot about it. Wherein he made a serious error. For Stet had been trained to accurate perception, even though the theory of the instruments was far beyond his savage mind. Furthermore, the Titans possessed several senses beyond those of the other denizens of the solar system—senses still not fully explained. They knew certain things intuitively which even the finest of instruments could not detect.

DAYS PASSED—that is, days ticked off by an Earth chronometer. The great space lab swung around the Earth like a stone in a gigantic sling.

The Moon bared its arid surface, passed slowly through its first phase, as larger and lesser satellite went into conjunction. Balto Dome heaved into view again. Its smooth bubble of ferro crystal was blankly dark. The Sun was an incandescent, burning glass, a molten fury of light; yet, close to its blinding rim, stars gleamed with serene, pure gestures. The planets moved in normal paths; the nebula made filmy veils against a jet-black profundity.

Yet Webb saw nothing of this. The plani-glass was polarized, so that only the filtered light of a shorn Sun entered. The repulsor screens were on full power. He was isolated from the universe. He was furiously at work, concentrated on a certain research, mathematical in its nature. He lived in a welter of integrals and vectors and tensors. He invented his own terminology. He was seeking the fundamental formula, the set of equations that would hold the universe within its symbols. He barely slept; he barely ate. Only Stet's hovering ministrations reminded him of these necessities.

The days wore on and on. And the giant Titan grew more and more uneasy. There seemed no end to this particular phase of his master's concentration. Stet swung with his queer gait to the outer detector screen, gaped at the tiny intermittent flash which showed that outer-space signals were vainly seeking entrance, returned to the central cell to peep in hopefully at Webb. But Webb never once raised his head. And again Stet retired, grumbling, rolling his eyes. His orders were strict.

On the third Earth day the signal grew more insistent. It was a continual flash. That, to Stet's mind, meant something most urgent, unprecedented. Some one was making desperate efforts to contact Webb Foster. With a scowl of determination, the Titan retreated to the inner cell. He tapped gently. No answer. He tapped again, harder. Webb raised his head angrily. A beautiful equation had been forming in his mind; this interruption had scattered the essential elements.

"Haven't I told you time and again not to interrupt me?" he exploded.

The giant ducked his head submissively. "Yes, master."

"Then what in Pluto do you mean by——"

"Some one making signal."

"Let them!"

"But they been making signal for three jumps," Stet insisted. A "jump" was his term for an Earth day. "They must want master very bad."

Webb grumbled, arose unwillingly. Why in Pluto had he built this space lab if not to get privacy? He looked regretfully at his calculations. But already the tag end of the equation had fled from his clutching brain. He might as well find out who wanted him with such vehemence.

HE WENT up the catwalk, stood frowning before the detector screen. The signal was a mute, persistent flash. Still grumbling, Webb thrust open the polarizing unit. At once the little flicker of light became an angry buzz. Webb looked startled, plugged in. That particular pitch described only one thing—the tight, restricted band of the Planetary Council—the rulers of the solar system. Only in cases of the utmost emergency was it ever used.

An angry, yet much harried face sprang into view on the visor screen. Hyatt Forbes, Earth representative! He was a bald old man with thin lips, a bold, decisive nose and eyes that were diamond drills. But just now there was mingled fear and relief in their depths.

"Thank Heaven you're still alive, Foster!" he gasped. "By this time I thought they had you, too." Then anger

overwhelmed relief. "Why the devil didn't you answer our call before this?"

Webb looked slowly around the encircling screens. One by one, other faces swam into view—faces of diverse nativity, of different shapes and characters. The lords of the solar system—the all-powerfuls—the Planetary Council: Ansel Pardee, director of the Moon—browned to brick darkness by the unimpeded ultra-violet of the Sun, a rock-hewn, determined man, vigorous, abrupt, fit descendant of the early Moon pioneers from Earth; Zog, tribal head of Venus, a pale-green creature with slitted, lidless eyes, pouched cheeks in which a species of gills extracted oxygen from the water-drenched atmosphere of his planet; Ixar, scientist of Mars, ocher-red, impassive member of an ancient race, infinitely indifferent to life, habituated to a dying world of desert sand; Qys, lord of the Jupiter planets, who ruled the circling swarm from his capital, Callisto—bleached skin and saucer eyes, to catch tired light, betrayed the distance of the Sun from his domains. Interior volcanic fires warmed his four habitable worlds.

And on all the faces shone similar emotions: anger, fear, uneasy, wary suspicion!

Webb took his time in reply—deliberately. When he spoke, his words were cold. "*You* know, Forbes, that I resent intrusions on my privacy. It disturbs my work. As it is——"

"Hah!" grunted Qys of Callisto angrily. "Perhaps he had a reason for hiding from our sight. I told you——"

"Please say no more," Ixar of Mars interrupted with quiet gesture. "Webb Foster is right. He is a scientist. That is sufficient explanation."

"So were the others," Ansel Pardee, Moon director, interrupted brutally. "We're warning him for his own good."

"And for the good of the system," Zog of Venus squeaked softly.

Webb Foster waited for them to cease their rapid-fire ejaculations. He did not fear them, though they were all-powerful in the planets. *He* was Webb Foster, premier scientist of all the worlds, accustomed to going his solitary way. But his curiosity was aroused.

"What," he demanded, "is the meaning of all this?"

Hyatt Forbes' baldish brow was furrowed with trouble. "It started with the ending of the assemblage of the scientists," he explained.

"They all left with me," said Webb. "I saw them off in their space ships, heading for their respective planets."

"That is so." Forbes nodded. "But a half dozen never got there."

"Lost?"

"That might account for Koos of Venus, and Larsen of the Moon. They flew their own ships. But An-gok of Mars and Yb of Io went on the regular space liners. They vanished in midspace, without a trace."

"And that isn't all," declared Pardee abruptly. He seemed the angriest of the council. "Since then a hundred more—the best scientists of the system—have disappeared. Four days ago I lost Jim Blake, my No. 1 Engineer, right out of the Balto Dome! I haven't been able to get a lick of work out of the rest of them since. They're scared to death."

"THE BALTO DOME?" Webb exclaimed involuntarily. That was where Stet had claimed he had seen unauthorized flashes four days ago.

"So that surprises you, Webb Foster?" Qys of Callisto grunted softly, his white skin twitching, his eyes rounder than ever.

"You will please desist from such comments," Forbes declared sharply. "The council has already discussed that phase of the matter and come to a final decision."

"Ah!" Webb's eyes glittered; his lips tightened. "So I have been the subject of a council decision, have I?"

he said slowly. "In other words, I am under suspicion."

"Not at all," Ixar of Mars murmured quietly. "It means only that our nerves are rasped; that, as scientist after scientist, the keenest minds of the system, vanished into nothingness, in spite of all protection, of all guards, suspicion was bound to flare up." He smiled the slow Martian smile. "We've even accused each other."

"Of what?"

"Of seeking to disrupt the council, of attempting to establish a personal dictatorship over all the planets. That is why the brains of the system are being removed—to make the path easier for the final attack."

"Do you believe that?"

The Martian's eyes slid around the circle of his co-rulers in the visor screen. "No, I do not. For none of the planets have been spared. It is my theory—and Zog of Venus and Forbes of Earth agree with me—that the danger lies from beyond the system. These men have vanished in spite of all safeguards. They have been plucked from the midst of the most sensitive warning instruments, without any vibration recording itself. This science is not of our planets. It must come from beyond, I fear"—and he paused to let his words sink in—"that this is but a preliminary invasion of beings from outer space—beings invisible to our senses and instruments, beings possessed of a science mightier than any of our contriving. We are in a serious danger."

Webb grinned wryly. He thought again of the disregarded warning the faithful Stet had given him—of strange fumblings along the pani-glass. Had the invaders thought that he, Webb Foster, was inside? Yet that did not sound right. For Stet had seen and heard the fumblings, the gropings, on the detector screens. Whereas Ixar had just said —— A startling theory flashed across his mind. Perhaps the instruments had shown nothing; perhaps it was the mysterious extra-sensory equipment of the Titan which had apperceived the disturbance, and attributed it to the screens. Good Lord! In that case——

He swung around the circle of the visor screens. "Thank you for the warning," he told them grimly. "I shall take the necessary precautions."

"We wish you to do more, Webb Foster," retorted Forbes. "You are the only one left in the solar system that can help us. We want you to trace this terrible business to its source. If what Ixar says is correct—and I think it is—we stand on the brink of some dreadful doom."

"I am merely a scientist," Webb pointed out. "You have your space patrols, your interplanetary guard. That is their job."

Forbes made a gesture of helplessness. "They've tried their best. Even now they're covering all the planetary spaceways, conducting a systematic search. And while they are searching, more men are being plucked from ships, from special underground chambers. They are being made a mock of; their formidable weapons are useless. Only your brains stand between us and disaster. If you should fail——"

"Thank you for an unmerited compliment," Webb interposed coldly. He knew he was still an object of suspicion. He could read the truth in the eye of Pardee of the Moon and Qys of the Jovian satellites. "There are others that are competent, or better, than I. I am extremely busy just now. Why not ask Ku-mer of Mars to try his powers?"

He caught the swift, blinking glances that flashed among them and wondered. Ixar took it upon himself to answer.

"Ku-mer," he said with quiet weariness, "was the first of the scientists to disappear."

Webb digested that. If Ku-mer, with all his vast resources, had been taken, then—— He looked longingly back to

his inner cell. He had been on the verge of that ultimate, universe-shaking equation. Now it would be lost—perhaps forever.

"Very well," he said. "I shall do what I can. But," and he cut short their buzz of approval, "I must be permitted my own methods, without supervision and without hindrance. And the first of my requests is that no hint be permitted to leak out of this conference."

"Agreed," Forbes said hastily—too hastily, Webb thought. For he saw the scowl on Pardee's face, the fierce suspicion in the huge eyes of Qys.

"Do you wish," asked Ixar with delicate intonation, "a patrol of ships around your laboratory?"

"Not a one," he retorted firmly. "I want, above all, to be left alone."

II.

WEBB FOSTER completed his preparations. They were simple. Nothing untoward showed on the surface of his plani-sphere. It is true that he polarized the surface, so as only to permit light vibrations to come through, but that was always done when he was at work. In the depths of his cell, however, he did this and that. Then he went calmly to sleep, a tiny pressure button concealed in his right fist. But first he ordered Stet to watch before the detector panel.

The huge black Titan goggled at him foolishly. "Master not going to make search like big council say?" he asked in hurt tones.

Webb laughed at his injured countenance. "No, Stet, I am not. As a matter of fact, I am going to let the invisible kidnapers come for me. I would rather meet them on my own terms."

The giant grinned understandingly. "You make yourself bait, eh, master?"

"Exactly. Now get to your post and remember your instructions."

The next few hours were difficult to bear. Webb pretended to be asleep, his eyes closed, his breathing relaxed, his right hand sprawling in a natural fist. Unknowing who the enemy was, how he would strike, or what his powers, he was determined to avoid all suspicion of preparedness. But, most of all, he relied on the extra-sensory perceptions of Stet. He was certain that his instruments would not register the coming of the stealthy invaders, but he was just as certain that the Titan's strange intuitions would feel their presence and give him warning in time.

Webb had never known space to be so quiet before. And airless space is at all times the very acme of silence. No air currents stirred or whispered with dry leaves; no distant water murmured plangent tales; no insects hummed their strident song; no plants swelled with sap and expanded with little crinkles of sound. He was alone in the universe. Stet, watchful before the panels, might have been on distant Betelgeuse.

Webb was a brave man, but this endless waiting for the unknown was an unbearable strain. He wanted to open his eyes, to move his cramped limbs, to scream out. He did not.

Then, suddenly, a cold wind seemed to stir over his heated forehead. It was Stet's voice, whispering along the thin wire next his ear, its resonance damped so that it was inaudible a foot away. "Master! I hear fumblings! I see a light on the screen! Master!"

Webb set his teeth, counted *ten* slowly. It was the hardest work he had ever done in his life. Then he pressed his button. Bathed in a sweat, he opened his eyes.

The cell was diffused in a strange, un-Earthly luminance. It was color, and it was not color; it was light, and yet it was darkness also. Webb had, by contacting certain concealed transformers of his own invention, brought all space waves, from the infinitesimal cosmic

rays up to the mile-long Hertzian pulses, within the range of visible light.

The familiar central cell seemed something strange, remote. He seemed in a different universe. He saw through the dural walls, pierced the mary dance of molecular vibration. But there was nothing else. His aching fingers, ready to press the button a second time—to create an impenetrable space warp around whatever it was that had come for him—relaxed. He uttered an oath. Stet had been premature—or mistaken!

SWIFTLY, he launched himself out of the chamber, up the catwalk toward the detector panel. The ebon Titan stood before the darkened screen, his eyes rolling fiercely, his gleaming skin bunched with moving muscles, his great hands flexing and unflexing as though they were already winding joyfully around an enemy throat.

"See, master!" he rumbled hoarsely. "He make signal on detector; he make noises fumbling around. Stet go get him."

Webb stared. The screen was a blank quiescence; the infinitely sensitive instruments showed no tiniest sign of disturbance. Nor, strain his ears as he might, could he hear the slightest sound. Yet obviously Stet saw and heard.

"Where do they come from?" Webb demanded quickly. He had had too many evidences of Stet's perceptivity to doubt him now.

The Titan strained, cocked quivering ears. "Outside Lock No. 1," he declared. "Where ship is."

Webb tightened his grip on the little, innocuous-seeming button, heaved with left hand at the flame gun in his belt. "All right, Stet; we're going for him."

The giant rumbled joyfully, jerked after him, stopped short with a grunt of despair. His black countenance puckered into woeful lines. "He gone now, master! He 'fraid!"

Webb believed him, and was himself afraid. For if the uncanny invader had retreated, it was only because he had known what Webb was about to do, had penetrated vibration screens and walls and space to know what Webb held in his hand, and what its powers were. How could one hope to fight an entity, invisible, all-seeing, to whom screens and thoughts alike were as a sieve?

Nevertheless, he raced up the swinging catwalk, hurled himself at the beleaguered lock, sprayed his deep-ray flash through the panels. Nothing untoward was there; nothing seemed disturbed. Grimly, Webb flung back to the control board, took the last desperate chance. He ripped wide the polarization, opened the plani-sphere to all space. He swung powerful search rays in great arcs—the space laboratory lay in the night shadow of the Earth—and watched with slitted eyes.

Suddenly, he exhaled breath explosively. Straight between them and the Moon, a tiny, two-seater space flier swerved and tumbled in mad anxiety to avoid the betraying glare. "There it is," Webb shouted. Yet even as he cried out, doubt assailed him. The flier to which his search ray clung with a bull-dog grip was no strange, otherworldish vessel. Earth was the site of its fashioning, and its handling was clumsy, inexpert.

Nevertheless, his lean hand darted for the switch that controlled the shouting penetron guns; his voice clipped into the microphone on the universal speech band. "Stop where you are," he ordered, "or I'll blast you out of space."

The tiny flier shuddered, rolled, quivered to a fumbling motion, parallel to his own. Alert, bright-eyed, Webb lashed out further orders. "Now come closer, slowly, carefully, with your magnetic grapple out, and attach to Lock No. 1. You'll find a signal light gleaming. But remember, make no false move. It will be your last, if you do."

Inexpertly, the little ship wavered

forward, along the clinging search beam, obedient to Webb's instructions. Yet he permitted himself no relaxation, no absence of precautions. There was something puzzling about the flier.

The grapples flung out; there was a slight shock, and the strange little vessel clung like a leech to the elephantine form of the planisphere.

"Watch it closely," Webb told Stet. "At the slightest suspicious move blast on the repulsor screen."

"Maybe then shoot with big guns?" the Titan suggested hopefully.

Webb shook his head. "No. It will be enough to fling it clear. I'll decide then on the next step."

Flame gun in hand, Webb swung up the walk, slid open the inner lock, trained his weapon on the outer door while the air rushed in. Then he moved forward cautiously, past his own auxiliary cruiser, sent the outer panel whirring into its recess.

"All right, now," he spoke softly into a wall microphone. "Open up and come in, hands high."

At the most, he figured, there could be three occupants of the two-seater. His gun was ready. It spurted searing flame in a wide angle. He would have the jump.

Slowly, the other panel, of dull dural, slid wide. Webb braced himself.

HE CRIED OUT sharply in surprise. The flame gun almost fell from lax fingers. Through the gleaming chamber, from the depths of the other ship, came—a girl!

Webb swore foolishly. "Who, in the name of Pluto——"

She swayed, stumbled toward him. "Thank Heaven it's you, Webb Foster!" she cried. "I thought at first it was—*they!*"

She was beautiful, and there was terror in her dark eyes. Her slender figure was graceful in the jaunty green garb of the Moon, and the clear, golden tan of her expressive countenance betrayed her origin.

Suspicion fled from Webb. His gun jerked back to his belt. "Take it easy," he commanded gently. "What were you doing out there in space, and who are *they?*"

She came closer to him. The terror seemed to slide out of her eyes. "I was on my way to Earth. I took off from the Balto Dome. About ten degrees out, a swarm of ships suddenly materialized. They were dead-black, strange, like nothing in the solar system. They tried to surround me. I—I remembered the queer rumors that are going about, and I turned and fled. They followed me. I was sure I was lost, when suddenly your search beam caught me—and they disappeared as suddenly as they had come. I am very grateful to you, Webb Foster."

Webb surveyed her keenly. She was enough to send any man's pulses pounding heavily. Her dark lashes flickered. She was, he decided coldly, lying. She was pretending terror, and she was watching him from under those maddening lashes to see how he swallowed her story. The tale of the black ships was a clumsy concoction. She barely knew the rudiments of handling a space flier; certainly she could never have given the slip to those against whom she was fighting. Furthermore, she was millions of miles out of her course, if her story were true.

Suspicion flared again. Was she perhaps the bait, attractive enough in all conscience, for the hidden entities who struck with impunity? What connection was there between her and the attempted invasion of only minutes before?

Nevertheless, he betrayed no outward sign of his unease. The game was obviously deeper than he thought. He would pretend to believe her story. "You're safe enough now," he said gently. "uh——"

"Loris Rham," she answered

promptly. The name came very pat. It was not her own, he decided.

"Suppose," he suggested, "I escort you back to the Moon. Your parents will——"

Her eyes widened. There was real pain in them. "I—I have no parents," she whispered. Then terror flooded her eyes—false terror. "Oh-h, I'd be afraid. Those horrible ships must be waiting out there. We'd never have a chance."

Webb grinned tightly to himself. She was playing a game. She had made her point—to get inside his space laboratory, and she intended to remain. Why?

"Very well," he answered dryly. "I'll have Stet, my man, make you comfortable." The jetty Titan lumbered forward, grinning horribly from ear to ear.

He was famous throughout the system, but few had ever seen him face to face. The girl took a short, backward step, stiffened, smiled brightly. "I'd love it," she said.

Webb, watching like a hawk, approved silently. She was no coward, as she had pretended. Stet, faithful, loyal, was not exactly a vision of beauty when first encountered.

But Stet was looking elsewhere. His eyes glittered on the built-in visor screen. "Master!" he rumbled. "Another ship—coming fast."

The girl whirled with a little exclamation of dismay. Webb pivoted like a cat. Had he misjudged her? Had there been truth——

The search beam picked out a blood-red flier. It slipped through space at a hundred miles a second, overhauling the ponderous plani-sphere as if it were motionless in the void. It was Martian speed craft, the fastest things in the system. There were only a few of them.

Stet moved with incredible lightness to the nearest penetron gun. The yawning orifice swung on noiseless gimbals, trained dead center on the approaching vessel.

"Wait!" Webb called out sharply. The girl was dismayed, without doubt; but it was surprise rather than fear that clouded her eyes. And she had spoken of black ships, many of them—not a solitary red Martian flier.

THEN his communication signal buzzed. He set it, waited warily. A voice leaped across the void—the voice of Ku-mer!

Webb Foster tightened his grip on himself. Was he dreaming? Ku-mer had vanished, the prey of the invisible invaders. Yet there was no doubt about his voice, and Webb now recognized the ship. The Martian scientist had taken off from Earth in that very flier.

"Webb Foster! Webb Foster!" Ku-mer's voice was hurried, anxious, quite unlike his usual bland repression.

"Speaking!"

"Good! I am in time then! You are in terrible danger, Webb Foster. I was afraid it had already struck. Make way for contact."

"Grapple on Space Lock No. 2," Webb heard himself say mechanically. There was much to be explained. He pressed appropriate buttons, flung out of the chamber, hurried along the swaying side platform to the other lock. Stet was with him. But only as the slides opened, and Ku-mer, second only to Webb Foster among the scientists of the planets, tottered in, weak and gasping, did the Earthman remember. The girl who called herself Loris Rham had disappeared while his attention was fastened on Ku-mer's ship!

Ku-mer was ocher-red, like all Martians. Among that race of scientists, inheritors of an ancient civilization, he was by universal consent the greatest. His hairless head bulged with profound thought and his eyes were wearied with the philosophic weariness of the Martians. Alongside Stet, even before Webb, he was puny, weak of limb. The Martians were not a strong race physically.

"Where, in the name of Pluto, Kumer," Webb demanded, "have you been?"

The Martian tottered, would have fallen had not Stet reached out a trunk-like arm, held him upright.

"I've been," he moaned, "to the ends of the system. I've been beyond Pluto, beyond the zone of comets, to a black globe known as Gar-Mando. Invisible creatures captured me on my way home to Mars, dragged my ship through the void with a speed beyond that of light. I beheld the dull black orb; I shrieked at the sight of what I saw writhing and heaving on its fearful surface; I lashed

out in utter despair with all the fury of my rocket blasts. Something snapped; I wrenched free. I fled weary days back to the system, with every ounce of power cramming the jets, to give warning."

"It is too late," said Webb. "Already they have struck, again and again. You were not the only one, Ku-mer, to be seized; though you were the only one to return."

The Martian cried out, gripped the Earthman's hand. "No one else can hope to combat this horror which is invading our peaceful planets, but you—Webb Foster—you and this great space laboratory of yours. I know you have weapons, inventions, which you have

A green Venusian body hurtled across the room, slammed into the electro-trepan, sent it crashing from its grooves.

guarded from disclosure. You alone can save the planets from utter, dire destruction. I tell you I saw them—have sensed dimly the mighty science of these denizens of outer space."

"You flatter me unduly." Webb smiled wryly.

"I do not," retorted the Martian. "The Conclave of Scientists has acclaimed you the greatest of us all."

Webb searched the ocher face for signs, found nothing but tremulous anxiety. "How about your own work?" he asked.

Ku-mer grimaced. "I work merely with the processes of thought with the physiology of the brain—stupid, useless research in the presence of this horror. But you—— It is fortunate you were not already taken."

"They tried," Webb assured him dryly, "twice. The second time was only half an hour ago."

The Martian's wizened face twisted in alarm. "Then there is no time to be lost," he urged. "We must not wait for anything. We must strike before they are able to strike again."

WEBB STARED at him with veiled eyes. But his thoughts were active. "Yes," he muttered absently. "It is time."

The great Titan scowled, bent his huge black head, grunted something in his master's ear. Webb did not seem to hear. His eyes were fixed quizzically on an inconspicuous, shiny disk in the palm of his hand. In its gleaming depths was mirrored a scene. The central cell of the plani-sphere. The girl Loris Rham was moving swiftly but stealthily about its narrow confines, peering in slide cavities, poking in all possible corners, riffling feverishly among the sheets on which Webb had been jotting his world-embracing equations. How could she know that Webb Foster saw every move she made in the miniature visor screen he held in the palm of his hand?

He decided it was time to call a halt to her searchings. There were many things in that particular cell it was not good for snoopers to discover. He went rapidly down the catwalk, Stet at his heels, Ku-mer, puzzled, in the rear. The Martian had not seen their surreptitious glances at the little disk.

Webb Foster thrust open the panel suddenly. "I hope," he said suavely, "you have not had the misfortune to discover what you are searching for."

The girl whirled with a startled cry. The sheets dropped from her slender fingers. Her hand went to her throat. A tiny pulse throbbed with maddening beat in the warm hollow of her smooth, golden-tanned skin.

"Oh-h!" she said faintly. "I don't know what you mean. I—I was just a trifle ill; my nerves—— I thought I'd come here and lie down a while."

Ku-mer bowed formally. "This is indeed an unexpected pleasure," he murmured, "to find Susan Blake here. I know your father very well; his is an exceptional mind."

Webb stared. Susan Blake! The daughter of Jim Blake, the Moon engineer who had vanished with the rest. He had known, of course, that Loris Rham was a glib pseudonym, but he had not known who she really was. Webb Foster had been a good deal of a hermit, absorbed in his scientific adventurings; otherwise he would have recognized Susan Blake. She was the toast of the planets.

He rolled the two names speculatively on his tongue. "Loris Rham! Susan Blake! Very pretty names," he murmured.

The girl flushed, then lifted her head proudly. "Yes, I am Susan Blake. I used another name until I found out—— I mean, I came to you for help, Webb Foster. My father has been taken. I am all alone. I wanted you to find him."

The frail Martian made clucking

sounds of sympathy. "Tsk—Tsk! Those devils caught Jim Blake? Too bad! He had a keen mind—a very superior brain."

The girl caught her throat again. Pain widened her eyes, "*Had!* Oh Lord, no! He is still alive!" Frantically, she clutched at Webb; imploringly her lashes quivered up at him. "Say you will help me find him. Please!"

Something stirred in Webb Foster's blood, something from which he had thought himself utterly immune. But his brain was a cold, intellectual instrument, standing a little apart, surveying him with sardonic amusement. It was the old, old game—as old as Earth itself, as ancient as primordial slime! Very well; let her think that she had fooled him. Was Jim Blake, by any chance, concerned in this business? He had heard tales of Blake! he was hard, ruthless, as most of the Moon colonists were.

Aloud he said, "We are going to find him now, Susan Blake." But there was a queer grimness in his tone that made her start, and caused the blood to ebb from her cheeks. He grinned sardonically. She understood what he meant.

III.

LIFE in the space laboratory became a tangled web of suspicion, fear and electric danger. Webb, following Ku-mer's careful instructions, sent the great orb hurtling from its path around Earth and Moon, catapulted it like a shining comet over the spaceways toward the outer limits of the system. The void was curiously empty. The great rocket ships, the lumbering cargo liners, were cowering in the planetary ports, afraid to risk the terrors of the invisible invaders.

Only the police cruisers darted like summer midges in vain search, poking angry noses among the asteroids, within the waste places of the huger planets. They stared curiously at the rushing might of the space laboratory. It seemed a tremendous portent, a planetoid trailing mile-long blasts of blazing gases. They signaled for it to stop; they even sent warning shells in its wake. For the Planetary Council had faithfully obeyed Webb Foster's request; it had permitted no word of his mission to leak out.

But the shells fell short of the planisphere's tremendous velocity, or, meeting it at an angle, exploded harmlessly against the repulsor screen. Pursuit soon fell behind, and hard-bitten patrol captains swore and burned the ether wages to ground bases querying Webb Foster's loyalty to the system. They did not know of Ku-mer's presence within the hurtling portent; they certainly did not dream that Susan Blake was on board. Only Ansel Pardee, director of the Moon, had any inkling of Susan's mission, and, hearing of the planisphere's sudden flight to outer space, his brow darkened and his heart turned to ashes.

Within the space laboratory, Webb Foster turned a puzzled frown on Ku-mer. "About how far out is this black planet called Gar-Mando?"

"Six billion miles."

Webb looked at him queerly. "Our top speed," he remarked, "is five hundred miles a second. At that rate it will take us one hundred and forty days. How," he asked, "did you escape your invisible captors and return within three days?"

Ku-mer's face was bland, inscrutable. He had recovered his former poise, his Martian impenetrability. "I learned much during the period of my captivity. You forget, Webb Foster, that my particular field is the study of thought. Through constant practice I have enabled myself to attune my mind to the thought vibrations of others—even of alien entities. I learned something of their mighty science—especially of the

secret of their locomotion. If you will forgive my short absence, I shall take the necessary measures——"

HE BOWED, glided from the living cells. Webb watched him thoughtfully as his frail, weak body mounted the swinging catwalk, disappeared into the lock where his little flier reposed securely. In fifteen minutes he was back. "Look at your speed indicators," he said softly.

Webb started. The wire-thin pencils of light were sweeping forward, arcing over to unbelievable slants. Already they were rushing through space at a velocity of two thousand miles a second, and acceleration was building up steadily.

"At twenty-five thousand miles per second," said Ku-mer, "we shall reach the black planet within three days."

"You mean——" exploded Webb.

"Within half an hour we shall achieve that speed."

He was as good as his word. Webb Foster stared with knitted brows into the electro-mosaics. It was incredible. The universe was a rushing wind streaming past the fury of their flight.

Qys, in his fastness on Callisto, swore unpronounceable oaths and sent tight-band code messages to his fellow members of the council. He was certain now that Webb Foster had betrayed them. Ansel Pardee, on the Moon, heard the warning and groaned. Susan Blake was being carried farther and farther away. He had not received the slightest inkling from her since she had started on her mission. Had Foster discovered her true identity—what her purpose was?

Within the hurtling plani-sphere Webb remarked casually to Ku-mer, "Just how did you manage it? My power loads show no perceptible increase."

The Martian scientist veiled his eyes. "How," he returned pointedly, "do you, my friend, achieve your effect of polarization?"

"Check!" Webb grinned, and asked no more. Ku-mer was joining forces with him to combat the alien invasion, but he was betraying none of the scientific secrets he had discovered.

The girl, Susan Blake, was a problem. Webb had given her privacy and living quarters in the farther cell of the central unit, and every sleep period he thoughtfully sealed her in.

She seemed gay, artificially so. She made it a special point to be with Webb whenever possible. She watched his every operation with veiled lashes, behind which the Earthman was sure a keen brain was probing. And she made no further mention of her father. He was disturbed—more than he cared to admit. He knew she was a spy; yet her mere presence, the utter feminine charm of her slender body, the heady wine of her long, slow looks, did things to his insides. He scolded himself for this sentimental weakness.

Yet his brain did not function when she was concerned as icily as it did with an essential problem in physics. He was following a fixed plan of action—or, rather, of inaction. This was to drift on the course of events, to do nothing positive, to permit all things to be done to him—and to watch for the main chance. Thus far the girl had come, Ku-mer had joined forces and was directing him to the incredible habitat of the invaders, and there had been certain tentative attempts to get at him.

He had no illusions; he knew he was in terrible danger; he felt that somewhere, within easy striking distance, the mysterious attackers were keeping pace with him, holding off for unknown purposes of their own. A slow grin spread over his face. Ku-mer had delved into the thought processes of his captors. Could it be possible that even now he was reading the depths of Webb's own thoughts?

THE GREAT SPHERE flamed beyond the last outposts of possible life. Saturn, with its whirling rings, lay far behind. Green-tinged Uranus, sad-eyed Neptune, and the sepulcher that was Pluto. Beyond lay shoreless space—unless, as Ku-mer had promised, the alien orb called Gar-Mando barred the path.

Within the space laboratory the tension grew. Susan Blake grew hollow-eyed and feverish, her last pretense at gayety gone. Webb caught her several times prowling among his possessions, and accepted gracefully her quick-witted responses. Once, he watched her stealthily entering the lock in which Ku-mer's vessel lay, saw her in his tiny visor screen, fumbling vainly at the sealed controls. The Martian held the secrets of his space ship well. With a grim smile Webb turned the little disk toward the sleeping scientist. He lay quietly in his bunk, unstirring; but Webb had an uneasy suspicion that underneath those motionless lids Ku-mer knew of the girl's prowlings, knew that Webb Foster was awake and watching.

Thoughtfully, Webb flicked off the disk, left Susan Blake to her vain spyings. Ostentatiously, he rolled over, as if restless in sleep, contacted a hidden wall panel. Invisible current flowed in a hollow shield around him. The tiny radiations of his mind beat outward, were circumscribed within the guarded area. Now he could think things out, without fear of disclosure. The Martian was his ally, but it was wise to withhold certain thoughts, certain plans——

"You're certain about the existence of the black planet?" Webb asked Ku-mer queerly. He had set and refined the various detectors of his rushing laboratory, but nothing quivered from the vastnesses ahead. Already the Sun was a pale, lifeless star behind, Earth and Mars forgotten dreams, and even Neptune a tiny speck.

The Martian's face betrayed no emotion. "Quite!" he murmured. "It is now only twenty million miles ahead."

"Then why," Webb demanded, "is there no sign of it as yet?"

"I did not tell you," Ku-mer said quietly, "but it is wholly invisible and self-contained—that is, until you approach within a million miles of its surface. The entities from beyond the universe have a mighty science of their own. They have bent light around themselves in a closed circuit. The radius of that circuit is a million miles."

Susan Blake flashed up with something of her old spirit. "You seem to know a good deal about these strange beings, Ku-mer."

The Martian scientist transfixed her with his regard. "I think I told you, my dear Moon lady, I possess some poor accomplishments in the probing of mind processes."

Webb tightened his lips. He seemed to sense a subtle threat in those velvet tones. Had Ku-mer penetrated the secret spying of the girl? Did he know exactly what she was after?

Susan shrank suddenly away, grew pale. Her eyes were wide. "I—I am afraid," she faltered. "We are heading into terrible danger. I want to go home."

"You are about five billion miles too late in your desire," Webb cut in sharply. "You should have thought of that earlier. Your little Earth flier, even if you were much more expert than you are, could never make it."

The girl took a deep breath. "I think," she said steadily, "I would like to try it."

"No!" The single syllable was explosive, curtly commanding. Webb looked at the Martian in some surprise. Ku-mer smiled blandly. "I mean," he amended, "that you are much safer here. Once beyond the confines of Webb Foster's laboratory, you will be caught. No doubt they are lurking, keeping pace with us. Only the mighty science of the

greatest scientist in the system is holding them at bay."

Little puckers furrowed Webb's forehead. The Martian was mocking him. He was showing his hand at last. That meant only one thing: that——

Webb Foster took a step forward.

"You had better slacken your speed if you do not wish to crash," Ku-mer said conversationally. "We have arrived at Gar-Mando!"

IV.

WEBB WHIRLED. There was no need to watch the detectors, nor stare into the electro-mosaic. Directly ahead, through the transparency of the planiglass, light flared in a molten flame, died almost immediately—as though they had crashed through some strange barrier. And directly ahead, black as a starless night, lay the outer planet of Gar-Mando!

Its size was not great—its diameter was under a thousand miles—but its Stygian surface raised the hackles on Webb's flesh. The Martian had spoken truly. There were things upon it that were not good for mortal eyes to see—things that heaved and billowed in long, sinuous undulations, things that reared monstrous heads from an endless ocean of black, sticky liquid, and gaped with mile-wide maws at the rushing planisphere. Behind him Webb heard Susan's gasp and Stet's native grunt. They startled him into action. He sprang to the controls, jerked the throttles of his cushioning rockets wide, blasted the repulsor screens on full power.

Nothing happened!

No power surged in the great tubes; no red slashes of flame roared from the rocket vents; the evanium lumps on which he depended for sub-atomic energy were cold and lifeless in the central disruptors. A crash was inevitable!

But even as the girl screamed and hid her face, their headlong fall to the terrible, unknown planet broke abruptly. An irresistible current caught the great space laboratory in its grip, swung it in a long, dizzying spiral to the heaving surface.

Stet, his black countenance ludicrously twisted, rolled howling along the catwalk. Susan Blake stumbled into Webb's arms, clung to him a moment in a tremblor of fear. Even in the lightning flash of events, Webb felt the supple warmth of her body, the strange intoxication of her beauty. His arms tightened. A moment she clung, then jerked free with a smothered cry. Was it fear, contempt, loathing, or——

Webb had no chance to know. For, from the farther side of the heaving planet, little space ships, black as the world that spawned them, came swiftly into sight. Ku-mer, miraculously erect, saw them come, turned to the panting Earth scientist with a little smile.

Webb Foster saw that smile and understood everything.

"So it was you, Ku-mer, all the time," he snarled, and dived for the flat little button that had been jerked from his hand.

"Don't move, Webb Foster," the Martian said calmly. The Earthman paused in mid-flight. In Ku-mer's fragile, red-veined hand a weapon pointed—a short-range blaster, sufficient to spatter them all into flying fragments, to smash Webb's finely balanced apparatus into irretrievable ruin.

The girl saw the threatening weapon and gave a choked cry. Stet, uncannily on his feet again, tensed his huge body for a smashing dive. A bull-throated roar vented from his throat.

"Stop it," Webb spoke sharply. The giant face screwed up in hideous protest, relaxed his quivering frame. Thereby Webb lost his chance of escape. For Stet would have died, but in the dying, his blasted flesh would have crashed into the puny Martian, thrust him off balance. And Webb Foster would have

been master of the situation, have had the opportunity to put into play all the subtle defenses he had contrived for just such an emergency. Yet, even with that knowledge, the Earthman could not permit the sacrifice of his faithful Titan.

IN ANOTHER MINUTE the interior of the great plani-sphere swarmed with the henchmen of Ku-mer—the scum of the planets—men of the several worlds, outlaws from the decrees of the council, desperadoes carefully gathered from the spaceways, ready to slit a throat or scuttle a luckless freighter with the utmost nonchalance. They were perfect tools for the sinister, deep-laid purposes of the Martian.

In utter silence, Webb permitted his arms to be pinioned. Stet shook off the first of his attackers like an elephant surrounded by snapping dogs, but a word from Webb brought him to scowling, unwilling submission. The girl was not bound.

She stood a little apart, slightly breathless, her color heightened. If there was fear in her, it did not show; if there was triumph, it, too, was veiled by long, curving lashes.

The sphere swerved, sped not more than fifty miles above the black planet, parallel to its heaving depths. Clinging to the sphere, guiding it on its flight, were the black ships of Gar-Mando.

Webb's thoughts were divided: horror at the abysmal creatures whose nightmare forms swirled in the slimy seas beneath; bitterness at the way in which he had walked into the neat trap set by Ku-mer—and wonder about Susan Blake. In the beginning he had deemed her the emissary of the invisible invaders—for he had placed no credence in the fantastic idea of entities from beyond the system. It had been a toss-up whether she had come from Ansel Pardee of the Moon, or had allied herself with Qys, lord of the Jupiter Planets, in a sudden bid for power. Then Ku-mer had injected himself into the picture.

With the knowledge of the girl's true identity, the whereabouts of her vanished father, Jim Blake, grew to certain proportions. Nor had the Martian himself been free from suspicion of collusion. But now——

"You had been preparing this coup a long time, Ku-mer," Webb said aloud.

The Martian bowed blandly. "Ever since," he admitted, "my researches into the essential nature of thought brought certain fascinating possibilities to light."

Webb looked puzzled. "Thought?" he echoed. "What has that to do with your present thrust for power, your kidnaping of all those who might have been able to oppose your will?"

Ku-mer smiled thinly. "Soon you shall see," he promised.

But there was that in the words which stirred uneasy sentations up and down Webb's spine.

They were flying steadily, scudding the surface. So low did they skim that hideous monsters reared themselves from the tarry seas, snapped with mile-wide jaws at the hurtling sphere—jaws that could almost gulp its bulk entire between serried, crunching fangs.

SUSAN BLAKE broke her long silence. She faced the Martian steadily. "I made a mistake," she said in low tones. "I thought Webb Foster was in back of all this; now I find it is you. What have you done with my father?"

Ku-mer surveyed her quizzically. "You are but a transparent child, Susan Blake," he said softly. "It is true you came to spy on the Earthman, but you suspected me almost at once. Do not imagine I did not know that you were vainly trying to penetrate the sealed secrets of my flier. It suited me to let you fumble on and on."

"Oh-h-h!" The girl stared at him wide-eyed. Anguish was in her voice;

her studied pose destroyed. "Answer me!" she cried. "Where is my father?"

Ku-mer smiled. It was not a pleasant smile. "Have comfort, child. You shall see him soon. He is on Gar-Mando."

She gulped and swayed. "Thank Heaven!" she whispered. "He is alive."

"Alive?" queried the Martian. "More than that. He is immortal!"

Webb Foster again felt that nameless shiver pass over his body. Ku-mer's words were cryptic, but they held sinister undertones.

All further speech, however, came to an end. For, in the distance, a huge island heaved into view. It was the only land Webb had seen in all their long flight around the strange black planet. And as land it was almost as forbidding, almost as dreadful, as the pitchy sea from which it reared its gaunt, steep flanks. Almost two miles high it jutted forth, a vast mountain *massif*, its sides perpendicular rock, black, unscalable, against whose smooth thrust the frightful monsters flung themselves and subsided with angry hissings, lashing the sticky liquid to a viscous, dirty foam.

On board the plani-sphere Ku-mer's henchmen sprang to their tasks under the Martian's soft-spoken commands. The black-beetle fliers quivered with sourceless power, swerved their gigantic tow aloft, braked its swift motion.

Gently, like a floating feather, they dropped to the surface of the island. It was curiously barren—a solid ledge of rock, smooth as a lava flow, its surface interrupted only by a set of buildings, low in height, sketchy in design, and obviously hastily constructed—typical pioneer buildings, for eating and sleeping, such as might be found on those of the asteroids where mining operations were in progress.

But two of the sprawling structures could not be classified so easily. One held Webb's straining eyes only momentarily. This was evidently Ku-mer's laboratory, the place in which he labored at his subtle psychological science. But the other!

It was small enough, and simple enough—in fact, a mere transparent dome, a semi-bubble set on the arid rock. Yet within its clear rotundity something sparkled and glittered. So sparkling, so glittering, that the great light dazzled Webb with its intensity, blinded him at first. It might have been a huge diamond, so pure and lambent were its rays; yet there was something else about it, even at that distance——

"What, in the name of Pluto, is it?" he gasped.

Ku-mer followed his captive's stare, and his own eyes flamed with light.

"That," he said in a hushed voice, "is my masterpiece, the fruit of years of ceaseless toil, the means by which I, Ku-mer, shall gain control of all the solar system." He turned slowly to the Earthman. "And you, my dear Webb Foster, whom the scientists chose as the greatest of them all, will add the final touch to my masterpiece, the final fillip necessary to consummate my plans."

THE COLD WIND of a strange premonition shuddered over Webb. "You know very well, Ku-mer," he rasped, "that I placed you in nomination for the honor."

For once the Martian's impenetrable surface cracked. His ocher face was a snarling mask. "That, Webb Foster," he mouthed, "was the ultimate insult. You knew quite well they would not vote for me. You pretended a magnanimous gesture—for me, the greatest scientist who ever lived. For that you shall pay; for that the whole system shall pay."

Suddenly, his face smoothed out; he was once more his usual, inscrutable self. "Forgive me, Webb Foster, for this silly outburst. It is unbecoming to me—the supergenius of the universe. In fact, I shall take pride in displaying to you my tremendous discovery. You are

probably the only one in all the planets who can understand it. I attempted explanations with the others. The explanations left them sadly befuddled. Regretfully, I was compelled to cut them short."

The great space laboratory rocked gently on its unstable base. At a word from their Martian leader, the outlaws hustled Stet out upon the bleak surface. Bound as he was, it took ten of them to force his great bulk along. Roughly, they pushed him into one of the buildings.

A smirking Venusian approached Susan. She flung his scaly green paw away with a shuddering gesture. "Don't you dare touch me!" she cried.

Ku-mer spoke sharply, and the Venusian shrank as if he had felt the lash.

Webb, tense against his bonds, relaxed. Whatever else might happen, the girl at least was safe from physical indignities. Ku-mer himself was notably ascetic, and the Martians were proud of their racial purity.

"You will not be harmed," Ku-mer assured her. "I have no need for women. Their brains are not—— But proceed through the lock, if you please. And you, too, Webb Foster." He gestured significantly with his blaster. "I shall be watching you; so shall my men. And remember, there is no escape from Gar-Mando."

Webb, stumbling through the narrow port, could well believe it. In all the Stygian planet there was but this solitary bit of land. All else was inky ocean, swarming with a nightmare life. A wan light beat on sea and land—a diffused glow inherent in phosphorescent air. Above, the bowl of sky was gray, finite. Light swung round and round in endless circles.

"A mere matter of magnetic deviations, controlled from my laboratory," the Martian murmured. "Gar-Mando was open to the solitudes of space before I came. I deemed it wiser to roof it in with invisibility."

"How did you discover this outpost of the system?" Webb inquired. "No one had ever suspected its existence."

"A certain pirate from the Moon blundered upon it unwittingly while fleeing an especially rigorous space-patrol pursuit. He recognized its possibilities, utilized it as a base for long forays upon the Jupiter satellites.

"Three years ago he was foolish enough to come to Mars for an interlude. He drank too much. I heard him. He sobered up—but I found means to make him talk. His followers decided to enlist under my banner. It took me a year to make the trip both ways, but I was enabled to establish the first transliteration of my matured theories." He smiled thinly. "The material was inadequate—chiefly members of my band who unaccountably disappeared—but it gave me my first start. Since then, through the kindness of the system's best brains, I have considerably improved my work." The smile tightened. "You, my friend, will have the glory of adding the final touch to my masterpiece."

V.

WEBB STIFFENED, said nothing. There was something horrible in the offing, something related to that dazzling entity within the farther dome. He stumbled on.

Susan Blake was at his side. Her dark head inclined to him; her eyes implored his own.

"I—am terribly sorry, Webb Foster," she whispered swiftly. "It is all my fault. I—I allowed Ansel Pardee to infect me with his own suspicions of yourself. My father's vanishment left me frantic, eager for revenge. Pardee outlined the scheme. He thought it might work." She made a hopeless gesture. "Instead, I ruined your plans, brought you to this horrible place. Forgive me. My father——"

"Do not blame yourself." Webb told her gently. "I knew you had come as a spy. I let you go on, thinking to find the truth between you and Ku-mer. I permitted him to catch me off guard."

The Martian and his men herded them through a panel in the bubble dome. Webb blinked his eyes. It was almost impossible to gaze steadily into the heart of the great shining orb before him.

"What do you make of it, Webb Foster?" Ku-mer asked ironically.

Webb stared from under narrowed lids. It was an incredible thing. As sight grew clearer, he beheld its fine structure. It was not a single crystal, as he had first believed; it was a conglomerate of separate crystalline forms, each a perfect octahedron; and they moved in swift, circling orbits within the outer round of racing crystals that held them all within circumscribed limits. The surfaces of revolution were each distinct, like the layers of an onion, but the paths described were not haphazard. They formed an inner symmetry, obeying laws of their own, weaving an intricate, yet orderly pattern in their flight.

Webb stared, and as he stared, the hair stirred on his head. For these were crystals such as he had never seen before. Each glowed with a strange, pulsing sheen; each moved and stirred within its depths with a warm, singing flame; each seemed a flashing eye that stared back at him and changed its hue with subtle, infinite shades of feeling. The Earthman felt strange, impalpable fingers plucking at his brain, stirring forgotten neurone paths, sending ghostly images into his innermost thoughts.

"What do you make of it?" Ku-mer repeated.

"Why, it seems alive!" Webb gasped.

"Alive?" the Martian scorned. "Earthman, you are gazing at immortality—eternal power!"

WEBB FOSTER was shaken to his depths. Those invisible fingers were still probing his mind, mercilessly, coldly, draining him. A dreadful suspicion grew upon him, vague, inchoate. But it was Susan Blake who, with the swift, mysterious intuition of womankind, discovered the incredible truth.

Her eyes were fastened on the shining race of tiny crystals with a strange intensity; her lips were parted with panting breath; her cheeks had paled to colorless tissue. She staggered, swayed. "Father!" she cried in toneless accents. "Where are you?"

"By the three rings of Saturn!" Webb gasped. Little shards of suspicion were fast falling into an unbelievable pattern.

"Ah!" Ku-mer breathed. "So you are both beginning to understand. The girl by mere intuition; you, by an effort of the imagination."

The Earthman was overwhelmed. Though his eyes smarted with pain, he could not withdraw his gaze from the shifting maze. "Good Lord! Do you mean that Jim Blake is—somehow—in that pulsing orb?"

"Not only Jim Blake, but a hundred others as well—the scientific brains of the solar system, the men who have—er—vanished. I have made them immortal, eternal, and, in return, they are yielding up to me all their knowledge, all their thought processes."

"But it's impossible!" Webb blurted out. His head was spinning. "How could you have transmuted them?" They had been his friends, co-workers, most of them, and now they were a single conglomerate of tinkling crystals.

Susan Blake, with a little sigh, quietly collapsed in a faint.

The Martian's face twisted with scorn. "I am disappointed in you, Webb Foster," he said contemptuously. "Perhaps you will not prove as valuable an addition as I had thought. You still do not grasp the beauty of my work. I was not interested in these men as individuals.

"Take off, Stet!" he shouted. But the Titan at the control board turned helplessly to his master.

It was as thinking machines that I wanted them.

"For twenty years I labored on my theories. Thought, I knew, was the lever by which life had elevated itself above the brute dance of atoms and electrons. Thought is all-powerful, a subtle, shining weapon with which to mold the universe to one's own desire. But evolution had stumbled. It had imbedded this magnificent instrument in a mold of sordid flesh, of slimy tissues and clotting blood wherein it is lost, scattered, fumbling darkly, subject to

ills and pressures and pains out of its own.

"For thousands of years the beings of the various planets bewailed this condition, but deemed it inevitable and inherent in the very structure of thought. For thought,' they told each other gravely, was but an electrical disturbance, an interplay of potentials between protoplasmic tissues in the brain. Destroy the brain, and the neurones of which it is composed, and thought dies with it, vanishes into nothingness."

"But the scientists of all the planets long ago proved that to be so," Webb protested.

"The scientists," Ku-mer snapped, "were a pack of fools. I am the first real psychologist. You are a physicist, yet you parrot such nonsense. The fundamental base of all your work is the great law of conservation—that nothing ever vanishes. Matter may change to energy, energy to matter, and both may shift their external forms, but the sum total is always constant, always the same. You must realize that."

"That is true," Webb admitted doubtfully. In spite of the dangerous situation in which he was, in spite of Susan's sprawled, motionless body, he was listening intently.

"Why then," the Martian continued triumphantly, "should thought, the highest, most complicated form of all in the entire universe, be the single thing to flash into being and flash out again without a trace? Thought, I insisted, must be permanent, durable. Then it couldn't be merely a matter of evanescent potentials. I went to work. For ten years I labored in my Martian laboratory. I used innumerable animals—the aakvelds of Mars, the mice and guinea pigs of Earth, the ytors of Venus." His smile was bland. "Yes, I used more advanced subjects—men of the planets of no particular importance, men whom no one missed.

"IT TOOK YEARS of heartbreaking toil, of innumerable initial failures. I removed the brains from the living creatures, kept them alive in saline solutions. There I subjected them to every conceivable type of stimulus. Finally, by using an electrical current of weak voltage but tremendous amperage, I found certain shining crystals oozing out of the tissues, moving to the cathodes. I purified these by fractional distillations, and tested them in a fever of anxiety. I implanted those I had obtained from Earthmen into the brains of mice, and behold, the mice spoke the language of Earth, displayed all the grades of intelligence that men of Earth possess.

"I had isolated the pure principle of thought; I had proven it to be a crystalline structure, of an atomic weight below that of hydrogen. It is the fundamental element of the universe, the substratum underlying all things. Long ago, certain metaphysicians declared the universe to be composed of thought; I have shown their mystical conceptions to be true."

Webb steadied himself with an effort. One part of his brain—the coldly scientific—knew this to be the greatest discovery of all time; the other part—the warmly human—realized the awful implications of what Ku-mer had done. Horror grew on him as he watched the whirling sphere of crystals. Each crystal was elemental thought; each crystal represented the painful evolution of uncounted aeons, each crystal was the life-in-death of a great scientist, of an erstwhile living, breathing human being!

"You have done a fiendish thing, Ku-mer," he said quietly. "You have perverted a truly great achievement to devilish ends. In your lust for power you have forgotten the suffering, the torment of these men whom you have coldbloodedly dissected. You have forgotten that they had friends, families"—his glance flickered painfully to the still

unconscious girl—"daughters. What can you gain to justify this horror?"

"You disappoint me," the Martian said regretfully. "There had been a time when I, too, believed in Webb Foster's greatness. Now I see you are but a fumbler, a mouther of stale emotions and cloudy phrases. What were these men? Mere mortal beings, alive for a few futile years, then condemned to rot eternally, their thoughts a moldering, scattered part of them. I have taken their minds, purified them of all dross, given them immortality, power, splendor. What happier fate could they desire? What more blessed state could you wish?"

Webb knew what he meant. For a fleeting moment he shrank, appalled, from the idea that he, too, was destined to be but an endlessly circling swarm of crystals within the shining sphere. Then he stiffened. "Thought," he answered quietly, "divorced from its human concomitants, emotions, desires, fumblings if you will, must prove a terrible instrument. Eventually, it must destroy its possessor."

"You speak nonsense," Ku-mer cried angrily. "I have found the means to control it, to force it to my will. See!" He darted to an instrument set in the curving wall of the dome. It consisted of a tessellated pattern, a gigantic checkerboard, each square of which was a vacuum tube. From it, wires trailed to the turntable on which the sphere of crystallized thought spun and whirled. Above the pattern bulged a complex of grids and transformers terminating in a mesh-type speaker. To one side, a delicate microphone was set into the apparatus.

THE MARTIAN stood before the microphone. "This," he stated, "is my control board, my method of communication with the fused pure thought of a hundred great minds. Already, through them, I have achieved a power plant which taps the stresses and strains of space itself for unlimited energy; I have bent light waves in complete circles around this planet, myself and my space ship, and utilized the resultant invisibility to capture more of the brains that I required.

"Had it not been for the extra-sensory equipment of your Titan, I would have seized both you and your space laboratory without the deception to which I was forced to stoop. Through the combined intensity of these minds, and yours, I shall gain the power I require to force all the solar system to my will. I shall become its sole ruler, its giver of laws. I shall be supreme!"

"Nevertheless, I still say," Webb declared stubbornly, "that the thought you have removed from its natural context will eventually destroy you."

Ku-mer laughed without mirth. "You are wrong, my friend. Watch, and I shall show you how it works." He spoke quietly into the microphone. "Give me the fundamental equation that expresses the universe entire."

Webb started, jerked against his bonds. This had been the problem on which all his energies had been concentrated at the beginning of this strange adventure.

Little wheels commenced turning within the apparatus. Lights flashed on and off. The sphere of crystallized thought took on a deeper hue. Its speed of inner rotation increased. The singing sound grew in volume. It became a chant, a mighty melody that filled the dome and fled beyond the phosphorescent air. It beat against the black, dismal cliffs; it lashed over the turbulent, monster-haunted flood of Gar-Mando; it sent the hideous creatures scuttling into the depths. The whizzing crystals spun on individual axes; they pulsed and glowed with a myriad rainbow hues, flashed with unbearable flame.

The distilled thoughts of the hundred mightiest minds in the universe were concentrating on the problem proposed.

Ku-mer's voice cut through the din. He was smiling a self-satisfied smile. "I have asked them the final question, the most difficult of all. Yet I know they will solve it. With this equation, all things will become self-evident. The universe will be an open book. Travel to the distant stars, entry into super-dimensions, control of elemental forces, the secrets of time and space themselves will be within my grasp. I shall become a superman, a god!" The feeble Martian body shook with the passion of his desire. His eyes glittered with devouring anticipation.

The shimmering sphere increased its pace. It rolled itself in a fury of concentration. Then there was a soundless burst of flame; the colors ebbed and faded; the tremendous speed slackened. Ku-mer rubbed his hands in an ecstasy of impatience. "Now I shall know—the ultimate!" he whispered.

A voice issued from the speaker. It was passionless, unhuman, the transformation of vibratory thought through the tessellated tubes into mechanical sound. In spite of himself, Webb strained to listen.

"We have merged our entities in the solution of this problem; we have concentrated our energies as never before. We do not know the answer."

KU-MER breathed convulsively. His red-veined fingers were clenched. "You—essences of pure intellect—the product of a hundred mighty minds—cannot solve the problem?"

"We cannot."

Ku-mer made a gesture of despair. "Is it then impossible of solution?"

"No. There is an answer."

Ku-mer's voice was choked. Webb Foster, in spite of himself, was a taut bowstring, waiting. "Where may I find it?" the Martian asked hoarsely.

"From one who is still alive—still cloaked in encompassing flesh."

"Give me his name."

There was a moment's hesitation. The sphere flared up, died down again.

"His name," it said, "is Webb Foster."

The Martian whirled with a strangled cry. His blaster snouted at his captive. "You? Webb Foster?" he cried. "You know the equation? Tell it to me—at once."

The Earthman grinned mockingly. No trace of his inner bewilderment showed on his face. Already Susan was stirring, the color mantling in her cheeks. "So that's the way the wind blows," he jeered. "Ku-mer, mightiest brain of the system—according to himself—and aided by the triple-distilled minds of a hundred notable scientists, must come to me for the underlying equation of the universe! There is infinite irony in that."

"Give it to me," shouted Ku-mer hoarsely. Gone was his Martian suavity, gone his poise and impassiveness. His hand shook; the veins swelled on his ocher forehead. At last the secret, by means of which infinity was his, lay in his grasp.

He did not know that the Earthman was thoroughly befuddled, aghast at his revelation of the whirling sphere. Webb knew quite well that he didn't know the answer, that he had only fumbled at the hem of the tremendous equation. Yet the crystals of thought had said that he knew. Why? Were they in truth but finite in their knowledge, even as the beings from whom they had been extracted, or was there something deeper in their passionless accusation?

His jeering was but a cloak, a stalling for time. He wanted opportunity to think it out, to seek a way to turn the sudden trend of affairs to advantage.

But Ku-mer pressed relentlessly. "Give me the equation," he reiterated with an access of deadly calm.

Webb shook his head. "Not yet. We must come to terms first," he said.

For a timeless moment Ku-mer's thin finger was on the trigger. Susan opened her eyes, tottered to her feet with a scream. Then the Martian relaxed, smiled.

"I am a fool," he spoke of himself, dispassionately. "I must purge myself of these silly emotions. I almost killed you, Webb Foster. That is over. You *shall* reveal the secret to me. Your isolated thought essence will join its fellows, will add the capping stone to my power."

He whistled shrilly. In seconds the dome swarmed with his men, alike only in their outlawry from the system. They seized the bound Earthman, the girl, carried them struggling and straining out into the weird phosphorescence of Gar-Mando, thrust them roughly into the laboratory of Ku-mer.

VI.

PANTING, heaving, Webb found himself stretched flat upon a dissecting table. Overhead, suspended from a crane, geared with an intricate web of meshing wheels, glittered curving electro-knives. Bound, helpless, Webb strained with all his might. A cold sweat burst out in great globules on his forehead. He knew what that maze of shining instruments portended.

It was an electric trepanner, with refinements. On the pressure of a button, the mechanism dipped smoothly into place, the knives cut with circular motion; the trepanned section of skull lifted into a special container, which whirred swiftly out of the way. Then a second circlet of knives, broad of base, wafer-thin, dipped, inserted themselves with delicate precision between skull and gray tissue, scooped out the quivering brain whole, intact. Next to his table was a glassite bowl, half full of a cloudy solution. Webb closed his eyes spasmodically. He knew what was to go into that saline broth.

Ku-mer was at his side, observing his frantic efforts with a scientific, detached interest. "You are a strange man, Webb Foster," he said. "I am granting you the sublimation of your mind, and you shriek out against it. Tsk—tsk! You must not struggle so."

"Damn you!" Webb gritted through locked teeth. "I am going to disappoint you even more than you think. I do not know the equation you desire. The crystals lied to you, or merely mocked."

Ku-mer staggered, then laughed. "They never lie, and being unhuman, do not mock. It is you who are lying now, Webb Foster, seeking to save your fleshy life. Your stratagem is childish." His arm raised; he pressed a button.

The current flowed into the trepanner; the gears started to turn. From somewhere, far off it seemed, a girl screamed. It was Susan, beating with vain fists against the close-crowding men. They laughed at her puny efforts. A shaggy Europan clubbed her brutally. She went crashing against the farther wall of the laboratory. Her body lay limp, motionless. She was silent.

Webb Foster knew he had only a bare minute more to live. Surprisingly, the knowledge did not frighten him. The electro-knives were dipping with unerring accuracy for the roof of his head. He stared upward, unblinking. He no longer struggled. He tried to visualize what would happen—the keen pain of the incision, the brittle crunching of bone. He had been given no anaesthetic, not because Ku-mer was deliberately cruel, but because for his purposes the brain must not be numbed by soporifics.

What, Webb thought with utter detachment, would be the sensation of death? Would there be awareness in

him when his brain pulsed in the saline bath? Would he remember himself, his past flesh-and-blood life, in the cold intellectualism that would be crystallized out of its infolding protoplasm?

Speculatively, he wondered what had happened to Susan Blake. He had heard her cry out; then all had been silence. A quiver went through him at the thought of her. Resolutely, he put it aside.

Ku-mer watched him in the scientific manner. Just as he, Webb Foster, had bent impersonally over an electron tube, or even a little mouse whose insides might give a clue to some secret of nature. Now he was the mouse. He understood the Martian. He was not torturing him for the mere sake of torture; it was a job to be done. The whole trouble lay in the fact that his science was not tempered with human mercy and emotions, that his drive for power was obscuring all other considerations.

But the others who crowded eagerly around the table were different. In their eyes was a strange likeness, dissimilar though they were in bodies. They were sadists, eager to drink in his dying screams, to see the swift blood spurt. Damn them!

The glittering blades grew large as the universe in his gaze. Involuntarily, Webb closed his eyes, braced himself for the unendurable pain. His teeth locked together. They would not hear him cry out; they would not see him wince.

SUDDENLY, the silent laboratory, breathless with waiting, was a roaring hell of sound. The soft whirring above his head faltered, withdrew. Angry shouts lifted; curses blasted in a dozen different tongues. But above all other sounds, dominating them like a Jovian hurricane, blared a bull-like roar. Webb opened his eyes incredulously. He'd recognize that great voice anywhere.

It was Stet, the Titan giant. Stet, raging in his incomprehensible native dialect, all English forgotten. Shouts, screams, cries of pain made an inextricable stew. A green Venusian body hurtled across the room, slammed into the electro-trepan, sent it crashing from its grooves. There was a medley of thumpings, the crunch of huge fists on pipe-stemmed bones, the soft whine in pellet weapons, the sear of flame guns.

Webb jerked his head around. "This way, Stet!" he cried out.

The huge Titan, black as the planet on which he stood, grinned horribly. He towered over his milling opponents like a California redwood over a sapling birch. "Coming, master!" he called. The next moment he was plowing like a space liner through the struggling outlaws, thrusting them in waves of broken bodies against the farther walls. Ku-mer tugged at his blaster, cursed a stilted Martian oath. It had stuck in his belt. He whirled, scuttled to the end of the room, disappeared through a panel slide.

In a twinkling the laboratory was clear of living beings. Only the dead remained, and the sorely wounded. Stet lurched grinning and bobbing to Webb's side.

"Quick, Stet!" Webb snapped. "Get these damned ropes untied. Ku-mer will be back soon, with reënforcements and plenty of blasters. We won't have a chance."

The Titan's clumsy paws fumbled with the bonds. Knots tightened all the harder.

"Here, let me do it," Susan cried, and thrust her slender form against the giant. With an amazed grunt, he gave way. Her fingers, graceful, skilled, literally flew. Knots loosened by magic, one after the other. And all the while she talked excitedly.

"What a great fool your Stet is!"

"Hurry!" Webb begged, cocking an anxious eye toward the still-quiet por-

tals to the outer rock. Then he asked, "Why?"

"Do you know what he did? They had thrust him into a cell, bound him with cords like these with a solitary Moon man to guard him. He could have snapped his bonds with a single ripple of those stupid muscles of his, and broken the Moon outlaw in two with his bare hands. But he was sitting there, quietly, comfortably, when I came. I had pretended unconsciousness until all attention was distracted to you. Then I slipped out, found a length of stellite bar, crept behind the guard who was watching Stet, brought it down upon his head. He dropped very quietly. I explained to your oaf of a Titan in one-letter words what was happening. For the first time he seemed to show a measure of intelligence. He started up, heaved, and the ropes went flying in all directions. Then he came running here, and I after him."

Stet grinned sheepishly. "Master tell me to stop back there in space lab," he defended. "He not change his order. Stet do nothing."

"We-ll," Susan sniffed, "I never——"

The last knot parted. Webb stumbled to his feet, free once more.

He wasted no time in bringing circulation back to his cramped limbs. Already the hard rock of the planet echoed with running feet. With a grunt of satisfaction he dived for a flame gun, dropped by a fleeing outlaw, hefted it in his hand. "Quick!" he snapped. "Head for our space lab. There isn't a second to lose."

THEY WERE outside again, running hard, heads lowered. Susan was between Webb and the Titan, partly shielded, by their bodies, from blasting weapons.

A shout stabbed through the weird half light at their appearance. The black plateau milled with a motley of planet scum. Guns lifted. A hole appeared suddenly to one side of Webb in the solid rock. A section of steel barrack hissed, collapsed in a shower of dazzling sparks and molten metal. The three fugitives darted around it just in time. Straight ahead, about a hundred Earth yards away, teetered the great planisphere, its bulk thrusting high into the glowing air.

"Run for it!" Webb said quickly. "You, Stet, get Susan Blake safe inside, start the motors. You know how."

The girl stopped short. "And you, Webb Foster?" she demanded.

He grinned. "I'm staying to slow them up. Otherwise none of us will get across that open space."

Her eyes were somber on his. "I'm staying, too," she said quietly.

"There's no sense to it," he rasped.

"There isn't," she admitted. "But I helped get you into this, and I'll bear the responsibility with you."

Webb looked at her tilted jaw and groaned. Seconds were precious. Already the pack was swinging around their temporary shelter. "All right, Stet," he said suddenly.

The giant grinned understanding. His huge arm whipped out, caught the girl's slender form, lifted her off the ground like a little child.

She struggled, screamed, "Let me down! Let me down! I won't go!"

But he was away with an easy lope, heeding her futile blows on his hard black chest no more than if they were the brushing of butterfly's wings.

Webb called after the Titan, "If I don't get to you when the motors start, head back for Callisto. You'll make it." Then, with a strange, empty feeling in his heart, he swung for the still-blazing edge of the hut, crouched.

The first wave of attack came hurtling, baying like hounds on their trail. He caught them unawares. His flame gun

spouted a long streamer of gas. The inflammable gas united explosively with the oxygen of the air, spread a wide sheet of flame over the oncoming men. There was a howl of pain, suddenly hushed screams, and half a dozen crisped bodies tumbled awkwardly to the rock. The rest recoiled hastily.

Blasters spanged against the barracks. More of it collapsed in flying globules of hot metal. Then there was silence.

Webb grinned tightly, catfooted quickly around to the other side. He had gauged their strategy correctly. He almost ran full tilt into a quietly tiptoeing party. Their guns went off simultaneously. Webb's jacket burst into flame. But the scouting group was wiped out, except for a single fleeing Martian. Webb raised his arm, aimed, pulled trigger. There was a hollow click, nothing else. He had used up the last cartridge.

WITH A GESTURE, Webb threw the empty gun away. If they came for him now—— But there was a short respite. The survivors were taking no undue chances with this crazy Earthman. They were reforming near the laboratory of Ku-mer, were pulling into position a short, squat tube with a yawning orifice. It looked very much like the trench mortar of an ancient day. Webb's scalp tightened. He knew what it was. A Martian *schoda*. It shot bolts of electrical energy. Even the plani-glass of his space lab would dissolve into vapor at the impact of that bolt, unless the repulsor screen were on full power. But would Stet know enough to turn it on?

He swung quickly around and ran for the plani-sphere. They saw him as he scudded across the bare rock. A dozen missiles flared and crashed around him. But the range was too great for accuracy. Once the *schoda* started firing, however——

He lifted his head. Stet and the girl had disappeared. The huge, translucent orb seemed miles away. Would he ever make it? What had happened to the others? Even as he queried himself, something came hurtling out of the open port of the plani-sphere. He gasped. Then another body followed the first, twisting and turning grotesquely in its trajectory. And a third! They fell to the inky rock with gruesome thuds, lay exactly as they had fallen.

Webb grinned and put on extra steam. Good old Stet! He was inside all right. Those were three of Ku-mer's guards who would never rise again. He was not more than twenty yards from the beckoning port, breathing heavily. The missiles had ceased, but he dared not turn around. All his energy was needed to bridge that last gap.

Then he heard a soft, hissing noise. With a groan, he flung himself flat on the ground. Just in time. The hiss became a crackling, the crackling a shriek, the shriek a cataclysmic roar, as though Gar-Mando had split in twain. A blue bolt ripped through the protesting air, hurtled directly for the huge round of the space lab.

Gasping, the breath knocked clean from his body, Webb squirmed on the ground. Almost reluctantly, he raised his head. It was all over. The plani-sphere that had taken him years to build, the two people inside, who, he realized now with a dreadful pang, were unutterably dear to him, were gone, smashed into flying atoms of gas. Never again would he——

An incredulous cry burst from his bleeding lips. The space lab, wreathed in blue smoke, was nevertheless intact. A familiar pattern of glittering pin points spangled its surface. The repulsor screen was in position! And Susan Blake, her slender form half obscured by the swirling smoke, was screaming at him from the port, calling on him frantically to run.

He obeyed. He came up like a racer, pistoning arms and legs. It took ten seconds to recharge the *schoda*.

Susan caught him as he literally fell into the opening. "Thank Heaven! Thank Heaven!" she cried brokenly. Her soft fingers stroked his grimy face, pulled away in abrupt embarrassment. Webb's pulses leaped. But first there was much to be done.

He sprang for the slide lever, closed the port behind him. Then he was through the space lock, running along the swinging catwalk. "Take off, Stet!" he shouted. "Take off at once!"

But the Titan at the control board turned helplessly to his master.

"I've been trying to tell you," the girl panted behind Webb's flying feet. "The controls don't work. Only the repulsor screen. We turned on everything. It's no go."

The Earthman slammed up to the silent screens, swearing. There was no doubt of it. Everything seemed in order. The rocket tubes should have been streaking red jets of fire against the rock. But nothing moved.

"It's Ku-mer," he said grimly. "I should have known he was up to something when he lighted out for his lab. He's got some blanketing ray on that penetrates even the repulsor screen. If that's the case——"

VII.

THE VISOR SCREEN glowed suddenly. The Martian's imperturbable countenance peered out from a misty background. His voice issued. Somehow he had managed to project the tight beam in back of the blanketing ray.

"Your temporary escape will not avail you, Webb Foster," he said. "You cannot leave Gar-Mando. Your planisphere is helpless in the grip of my interference scrambler. You had better give yourself up before I blast you all into nothingness."

"Don't listen to him," Susan cried. "He's bluffing. The repulsor screen——"

Webb stared at the composed features of the Martian. "No," he answered quietly, "he is not bluffing. He can do it. But"—and he grinned at the pictured representation—"you won't."

Ku-mer looked startled. "Why not?" he inquired.

"There are two reasons. The first is that you haven't had a chance to examine all the details of my space laboratory. There are many inventions here even you don't know as yet. And the second is that if I die—except under your electro-trepan—you will never obtain the secret of the ultimate equation that explains the universe."

The Martian scientist looked at him thoughtfully. "You are right, Webb Foster," he admitted. "But there are other ways——" He left the rest suspended, while the visor screen faded into gray blankness.

"What can he do?" the girl asked anxiously.

"Plenty!" Webb answered quietly. "There are certain anæsthetic gases he can pump through. If only——"

He went to work, Susan and Stet aiding wherever they could. He tried new combinations, rigged up special batteries, experimented. But the screens remained dead, the central firing chamber was cold and lifeless. "Why," he wondered aloud, "do the repulsors work when everything else is blanketed?"

It was a question that started him off again, frantically, feverishly. The repulsor elements tapped subspace, and hence were unimpeded by any waves in normal space time. But no one, not even Webb himself, had ever discovered a method of utilizing this queer repellant property for any other purpose. He tinkered, swore, computed frantically—without result. He stared at his equations with haggard eyes. They were

meaningless brawls. And Ku-mer was doubtless at work also, wasting no time.

"Webb Foster!"

He jerked his head up. There was something in Susan's still, small voice that sent a spasm of alarm through him. She was swaying against the wall, her hand fluttering at her throat. She was pale as wax, and she seemed to have difficulty in breathing.

"I—I——" she whispered thickly, and fell.

"Good Lord!" He sprang to his feet, or thought he did. But actually he gave the effect of a delayed televisor representation. His limbs seemed twice their normal weight, his head pounded dully, his tongue clove to the roof of his mouth. In the distance, dimly, through blurring eyes, he saw his faithful Titan, a huge, black bulk, sprawled next to the control screens.

"The R gas!" he muttered painfully. Colorless, odorless, it had stolen unawares through the plani-glass behind the interference rays. No material known to the planets could hold out its penetrative molecules.

BLINDLY, he heaved himself erect. Like a swimmer in an asphalt sea, he lurched forward—not to Susan, not to Stet. He could do nothing for them—but to the space-tapping machine that powered the repulsors. There was only one course left.

If the power were reversed suddenly, the quick shift in subspace configurations would create a temporary dislocation between the two dimensional space times. Such a dislocation would have obvious consequences. Once Webb had seen a patrol ship go out like a puff of smoke against the heavens. A drunken member of its crew had thought it might be sport to swing the lever controlling the screen.

It meant annihilation, of course, but rather death than that Ku-mer should gain control of the plani-sphere and of his brain.

The haze in his mind grew thicker. His muscles would soon refuse to obey his will. The subtle gas was cumulative in its effect. He must do it now—or not at all. In a blur, he staggered toward the fatal lever.

Some one was speaking to him. He shook his head drowsily. It was an illusion born of the R gas. He must—— The voice grew sharper, more penetrating. It held a curious unhuman timbre.

Weighted hand on lever, he turned bleary eyes upward. The visor screen was lighted. A shock went through him. He almost fell. He barely got his hand away in time. Another shove, and the rod would have swung down.

In the screen he saw a whirling, dazzling sphere—a sphere in which concentric layers whirled in order dance. The sphere of crystallized thought! It spoke. "Webb Foster! Webb Foster!"

"Wh-what d'you want?" he answered thickly.

"Do not reverse the repulsor screen. Turn it off instead."

Webb shook himself dizzily. "But why——"

"Turn it off," repeated the sphere of thought coldly.

Suspicion flared in his dulled mind. This was Ku-mer's work. The shining orb was under his control. Once the repulsor screen was open——

The distilled intellect of a hundred men must have known what he suspected. Again its unhuman accents broke on him. "Webb Foster, it is Jim Blake who tells you this. It is for Susan——"

Susan! Jim Blake! Had he been fully awake, Webb might have refused to fall into what seemed a specious trap. But the names acted like magic talismans. Summoning up the last ounce of strength he swung the lever—toward the right—toward zero.

THE sparkling pin points on the plani-glass died. The great space laboratory was open to the least vibration. But in that moment an invisible flash seemed to hurtle through the vast interior, a whoosh as of clashing waves. Suddenly, the central firing chamber flamed into being; the evanium pellets disintegrated; their subatomic energy flared outward through the rocket tubes, lashing the black rock with searing gases. The plani-sphere catapulted up into the phosphorescent air! All the machinery of the laboratories hummed and whizzed and turned.

Webb had been flung from his feet by the sudden acceleration. Slowly, he staggered upright again. His brain was clearing rapidly as the R gas attenuated. Already Stet was heaving his vast bulk foolishly erect. Susan opened her eyes in bewilderment.

But Webb was in furious action. He sprang to the various controls, set them on their courses, restored the repulso screen—just in case Ku-mer had thought quickly enough to sight the *schoda* on their upward zoom. Then, grimly, he leveled off his flight, poised the great space lab directly over the swarming plateau.

Susan swayed to his side. "Why don't we escape?" she cried.

Webb's jaw was hard. "First I want to blast Gar-Mando out of existence. Ku-mer is too great a menace to the peace of the planets to remain alive."

His fingers tightened on the trips of the snouting blasters. Their ugly orifices trained down on the black plateau. In the screen they could see the outlaws, like a swarm of ants, running aimlessly back and forth, pouring futile pellets at the hovering ship. Ku-mer was nowhere to be seen.

The girl caught Webb's hand with a little cry. She pointed. Far beneath, like a variable star, the orb of crystal thought was pouring a blaze of glory through the transparent hemisphere of inclosing quartz. Never had they seen it so dazzling, so alive. "My father," she said with a catch in her voice. "He's in there. He, too, will be destroyed."

Webb's eyes clouded. He thought of that strange breaking through of Jim Blake—of the triumph of a long-dead emotion over the impersonal intellectualism of the crystals—of the warning that Jim Blake, a mere series of octahedrons, had managed to convey.

"I think," he said softly, "your father—and all the others—must know what we are about to do. What you see is their paean of victory, their welcoming of sweet oblivion. Pure intellect, divorced from all warmth of human relations, all the loveliness of human forms and sights and sounds, must be a frightful thing. Jim Blake knows—and approves."

Hastily, he sprang the trips. The great blast shells dropped at terrific speed. The still-firing outlaws saw them coming, fled howling in all directions. Then the mountain of black rock seemed to heave on its base. It blasted open like a volcano, spouted huge geysers of molten magma. The plateau shuddered, split wide, and toppled in a ruin of flaring fragments into the inky seas. The wide-lapping liquid tossed and boiled like a cauldron of hellish brew. Vast monsters, incredible in size, obscene nightmares beyond all human imagination, erupted from the sticky, foaming depths, flung high, and dropped back with the crash of a thousand Niagaras.

NOW the planet of Gar-Mando was an uninterrupted ocean. The mountain plateau, solitary bit of land, was no more. Of all the buildings, of all the scuttling men, not a trace remained.

But Webb had seen, or thought he saw, the crystal globe that represented a hundred men burst open like a shower of bright sparks. The separate sparks

fled in all directions, on a curious, singing note, upward through the phosphorescent air, out into the sudden space beyond. For with the destruction of Ku-mer's laboratory, light was no longer curved, and far above blazed the familiar stars, while the Sun, a slightly larger star, blinked in amazement at this strange addition to its family.

Susan stood very erect. "Poor father," she said quietly.

"I am not so sure," Webb murmured, holding her hand in his. "Thought is indestructible. It is the subelement beneath the tiniest wave lengths. No mere explosion could break it down. All I did, I think, was to separate the hundred martyrs from one another, scatter their crystal units into the all-embracing mother—*space*. Perhaps, my dear, that is all that death itself can do."

She digested that. Perhaps it brought her a measure of comfort. "But how," she changed the subject, "did the opening of the repulsor screen release us from Ku-mer's grip?"

"I think it was due to the nature of the interference waves he set up. Obviously, though I didn't realize it at the time, they must have had trains in subspace also. Otherwise the repulsor screen would have remained unaffected. By cutting off my own power, to which it had been carefully attuned, I thrust the whole wave system off balance. As a result, the interference no longer held good, and my own units started functioning again."

Susan took a deep breath. "We had better be starting for our own planets," she said, "now that Ku-mer is dead."

"Ku-mer not dead!"

Webb whirled. It was the Titan who had spoken. His black face was a tight, screwed mask. "What do you mean, Stet?" the Earthman demanded. "Of course he's dead. We blasted him and his island to smithereens."

But the Titan held his ground. "He not dead," he insisted stubbornly. And Webb, knowing the peculiar other senses of the Titans, felt a cold wind ruffle his hair. He shook his head half angrily. "Don't talk nonsense," he snapped. "Set our rockets for Earth. It's a long trek this time—without the Martian's secret power acceleration."

"Yes, master," the Titan said stolidly, and shuffled to his duties.

"How long will it take?" asked Susan.

"About one hundred and forty days, Earth time."

The girl looked at him impishly. "At least," she said softly, "it will give us time to get acquainted."

SPACE BLISTER

by John D. Clark, Ph.D.

As he stepped through the iridescent film he felt a sudden wrench—not quite physical—as though every atom in his anatomy had flopped—turned over.

WE used to think that we knew what space was like. Space—that intangible nothing in which matter floats, and whose very existence is caused by the matter within it. And we thought that we knew what the properties of space were. But we know better now. At least we know that we do not know, and that is the first and most important step in all knowledge.

On September 15, 2157, Carter and Poggenpohl—Jimmy and Mike, respectively, the head of the astrophysics department of the Mt. McKinley Observatory and his chief assistant, were spending an afternoon in the observatory laboratory, pretending to work, but in reality loafing with the finesse that comes only from long practice. They had license to loaf, and considerable excuse. Not many months before they

had been out in space, driving the menace of the minus planet away from the earth, and their vacation had not yet officially ended.

But the lure of the laboratories had been too strong, and they had mutually surprised each other by simultaneously appearing at the observatory airport, each one forced to admit that he had been bored with his vacation and that he preferred to loaf with the tools of his trade around him.

Right now Jimmy was setting up integrals on his huge mechanical integraph and then knocking them down again, while Mike was busily engaged in drawing imaginary and highly improbable animals all over his desk blotter. They had prowled around the buildings, and had found all the other men busily at work, so efficiently that their assistance had been rejected with scorn and bad language.

Mike squinted one baby-blue eye at a particularly outrageous animal which he had just created. "Jimmy," he said, "this is driving me nuts! If something doesn't happen pretty soon I'm going out and start a war on my own, just for the excitement!"

Jimmy punched a key on the integraph and pressed the starting button. The machine clicked and whirred and informed him that the integral of e^x was also e^x. He unfolded his lanky length, yawned with vigor at the mathematical platitude. "I doubt, Mike, that that would be a solution to the problem that is preying on your alleged mind. You would probably land in jail in about thirty micro seconds, and some of my best friends have informed me that nothing is more boring than life in durance vile. What do you expect? Do you want to save the world twice a day?"

"Couldn't be as bored in jail as I am now. I—— Damn that communicator!"

It was buzzing and blinking frantically, as his companion leaned over and pressed the answering button. The view plate lighted up, showing a pallid face surmounted by a shock of bushy, black hair. "Hello! Carter speaking."

The instrument spoke. "Hello, Dr. Carter. I'm glad I caught you! I'm Dr. Quintana of the University of Mexico City. I'm up at Wiseman, two or three hundred kilometers northeast of you."

"Glad to see you again, doctor. Haven't seen you since that emergency meeting in Washington two years ago. What can I do for you?"

"Will you come up here now, right away? A terrible accident has happened!"

"What? What do you mean?"

"I started an experiment and it got away from me. I can't stop it. If you will come now, please——" There was a crackling sound from the speaker, and the plate went blank.

Carter vainly attempted to renew the connection and then turned to his assistant. "It appears, Mike, that your wish for excitement will be gratified immediately, if not sooner. We'd better be moving."

"Looks that way, Jimmy." Mike ran his fingers through his flaming hair, until he looked like a red-quilled porcupine. "Sounds like something serious. Quintana's a damned good man."

"He is. That work of his on space constants at the last physical society meeting was a good job. If *he* says it's terrible——" He switched the communicator to the hangar, and then the two men headed toward the airport.

AN HOUR LATER they were approaching Wiseman. The little town, long since deserted, lay in its cup in the Endicott Mountains, shadowed from the low sun of the autumn evening.

"What's Quintana doing in this God-forsaken hole, anyway?" wondered Mike. "Say—what's that thing?" He

pointed to the northern slope of the valley.

Carter strained his eyes. There was something queer about the little house near the top of the hill—something that he could not quite define. It looked oddly distorted, and it was hard to see its real shape. There was a queer iridescent *something* around it, as though it were inside of a soap bubble. "I don't know," he answered in a puzzled voice. "It's like nothing I ever saw before. We'd better take a closer look and see what's the matter with Quintana."

The helicopter screws buzzed and the plane settled softly to the ground. Yes, there was something over the house: a hemisphere, quite transparent, but greenishly iridescent in the uncertain light. It was perhaps eighty meters in diameter now, and appeared to be growing very slowly. They stopped short before it, hesitant.

"Wonder if it bites?" asked Mike, tossing a stick at it. The stick passed through the iridescent wall as though it were not there. Then he touched it gingerly with his extended little finger. "Nothing there, Jimmy. Can't feel a thing. I'm going to take a chance!" He took a long breath, and stepped through.

He grunted and staggered as though he'd been kicked in the stomach, and then stopped short, with his eyes and mouth popping open. He gulped. "For the luvva—— Jimmy—come in and have a look at this!"

Carter followed him through the impalpable barrier. As he stepped through the iridescent film he felt a sudden wrench, not quite physical, as though every atom in his anatomy had flopped and turned over simultaneously. Then he, too, stopped, and his mouth opened in amazement. The sky was black. The grass was a dark violet, and the autumn leaves, which should have been red and yellow, were blue and violet. His hands and Mike's face were blue-green, and the latter's blue shirt was black, while his orange tie was blue. His own white shirt was still white, but the other's red hair was a stunning emerald-green.

"Mike," he said with careful calm, "am I crazy or are you?"

"Dunno how you are, Jimmy, but *I'm* seeing green sunsets and purple poppies! There's something screwy, that's a cinch! Where's Quintana?"

"We'd better find out, quick! Even if this state of affairs isn't dangerous, he'll probably have gone crazy, anyway!" The two of them broke into a run toward the house, whose original color it was impossible to guess, but which was now a violent blue-violet. There was no sign of life on the outside, nor did repeated poundings on the locked door produce any results. Carter stepped back a pace, smashed through the door. Quintana lay still on his face before the communicator, which was nothing but a mass of fused and smoking wires and tubes.

"Still alive," remarked Poggenpohl, feeling the pulse. "But he's pretty badly burned around the face and hands. We'll have to get him to a hospital."

"See what you can do for him right now, Mike. I'll take a look at what caused all this." He stepped into the next room, which had evidently been fitted up as a laboratory. Now it was a smoking ruin, with shattered fragments of electrical apparatus littering the room, particles of fused glass crunching under his boots, and a tangle of twisted aluminium girders, fused copper wires, and broken castings in the center of the room.

He shrugged his shoulders, and rejoined Poggenpohl. "Nothing but a lot of wreckage, Mike. It'd take a miracle to find out what did all this. Here, you take his feet and I'll take his head. Good. It looks like every piece of electrical apparatus in the place blew out at once, violently. Let's get him to the plane for a little first aid."

THEY tramped back across the outrageous landscape toward the wall of the incredible bubble, carrying their unconscious burden between them. The wall was a little farther than it had been; it was still growing slowly. They slid Quintana into the cabin, and Carter took the controls for the take-off, while Mike brought out the first-aid kit and did his best to treat the terrible burns on the victim's face and hands. He made no effort to bring him back to consciousness, judging that it would be a mercy to leave him in a coma.

"Have you any ideas at all about what started this, Jimmy?" he asked, as he poured the tannic-acid solution over the burns.

"Not the vaguest." Carter switched the power from the helicopter to the propulsion propeller and the plane shot forward at an accelerating rate. "Your guess is as good as mine. The whole thing doesn't make sense at all, but maybe we can make a sensible guess when Quintana comes to. He ought to know something about what he started."

"Golly! I hope he does! If not, we're sunk without a trace."

"Right-o! That damned bubble or blister, or whatever it is, is growing, and for all I know it may cover the whole earth before it quits—maybe the whole system!"

"Well, I'd sure hate to have to go around all my life looking like you did a few minutes ago! That violet complexion——"

"Agreed. You looked like something out of a graveyard yourself. Zombie or something like it."

"Ugh!" said Doc Mike, and turned back to his patient.

Carter turned the plane toward Fairbanks, the nearest large city where there would be an adequate hospital and specialists capable of taking care of Quintana's burns, while his companion radioed ahead for an ambulance to meet the plane when it lighted at the Eielson airport.

FIVE HOURS LATER Quintana returned to consciousness. At first he was silent, but as he gazed in bewilderment around the hospital room his eyes met Carter's, and he seemed to understand his situation. "How do you do, Dr. Carter," he said weakly. "Thanks for coming around when I asked you. Where am I now, by the way?"

"You're in the hospital at Fairbanks, doctor. Your communicator blew up in your face and we—Dr. Poggenpohl and I—brought you here. You're rather badly burned, but there's nothing to worry about."

"I see that there's something else I have to thank you for, then. But that is not important. Tell me, did you see what has happened at Wiseman?"

"Well, there's a queer sort of bubble around your house, and inside it all the colors are wrong. And the bubble is growing steadily. Do you know what caused it?"

"Yes—and no. This is what happened. I was on my vacation—I go up there every fall during the hunting season. To amuse myself I started investigating the old Einstein Field Theories, connecting all the different sorts of fields in space: electrostatic, magnetic, gravitational, and so on. It's an old field theory, but I wasn't so sure that it had been completely worked out. I set up my apparatus to try to change the gravitational fields in a small segment of space by the application of various intense magnetic and static fields, varying according to a Weirstrauss function. You'll find all the details in the notebook in my coat pocket.

"Anyway, I warmed up the apparatus, closed the switches, and was looking through my observing telescope at the spring balance I was using to measure the gravitational field between the poles of the apparatus, when, in

reaching for my notebook, I must have closed another switch by mistake—the one that started a simple elliptically varied magnetic field.

"The machine made a queer, grunting noise, and the weight on the spring balance sagged way down and then shot up through the top of the apparatus, and the tubes began to get red-hot. I cut all the switches, of course, but when I did there was a loud pop and a squeal and an iridescent bubble about a meter in diameter suddenly appeared surrounding the center of the apparatus, which was getting hotter and hotter all the time. The bubble started to grow, too, moving right through the solid parts of the set-up as though they hadn't been there.

"I tried everything I could think of to stop it, and then I recalled that you had discussed some of my work with me, and remembered that your post was quite near. But when I called you, evidently everything blew up at once, for the next thing I remember is waking up here. But did you say that the colors are wrong? And how big did you say the bubble is now?"

Carter explained the situation, and Quintana groaned. "It has to be stopped some way, gentlemen! If I were not here——" He tried to get out of bed, but the physician pushed him back.

"No, Dr. Quintana. You must stay here for a week at least. So don't excite yourself. I am sure that Dr. Carter and Dr. Poggenpohl will be able to do anything that has to be done." His voice was soothing, and as the two physicists added their own reassurances to his, Quintana fell back on the bed.

"Do you feel as confident as you sounded?" Mike asked, as they rode back to the airport. "I know I didn't!"

"Neither did I, if you want the truth! This notebook"—he slapped it on his palm—"may help some, but right now I haven't the foggiest idea of what this thing is or what to do about it——"

"Or whether anything at all *can* be done about it!" Mike added glumly. "I'm scared a bright green with purple spots myself! I don't like this business."

"There isn't anything we *can* do about it until we know what has happened. There's no help for it. We've got to go back there and do some real investigating. And we'll need a lot of apparatus to do a good job, too. So first we'll head for the observatory, get some sleep, and start the job to-morrow."

"O. K.," agreed Doc Mike. "Particularly on the sleep question. The trouble with this science business is that it breaks into your rest so much."

BY THE TIME their heavily loaded plane landed again near the bubble the next morning, the bubble had grown until its diameter was almost twelve hundred meters. "One thing we have to do, Mike, is set one of the assistants in the other plane to measuring the rate of growth of this animal. Then at least we'll know what we're up against—maybe!"

The landscape was as weird as ever—even more so than before, under the full light of the sun, which appeared to be a brilliant blue-violet. The two scientists and their assistants set themselves to make an infinity of measurements of the natural physical constants inside the bubble. They noticed as they worked that the sun appeared to be more powerful than usual, and soon started to itch and burn on every square centimeter of exposed skin, but were too busy to pay any attention to the phenomenon until they stepped out into the normal world some hours later. Then they knew what the trouble was.

"Good Lord, Jimmy! You look like a broiled lobster! That's the swellest case of sunburn I've ever seen!"

"So *that's* why I feel like I'd been eating crackers in bed! Your case is

a honey, too—and take a look at the assistants!"

The sunburn was the most serious that any one of them had ever experienced, and put most of the crew in the hospital. Carter and Poggenpohl consigned their doctors to the devil, and refused to go to bed. Instead, they smeared themselves liberally with tannic acid, and stuck it out. But the remainder of the work that had to be done in the bubble was done by men wearing light metal helmets with anti-ray eyepieces, and wearing opaque clothes and gauntlets.

They measured all the important constants of space: its curvature, the velocity of light, the mass and charge of the electron and the proton, Plank's constant, and all the rest. The work was not completed until September 20th, five days after Quintana's accident, and by that time the bubble had grown until it was almost eight kilometers in diameter.

The two physicists returned to their laboratories on Mt. McKinley to try to make sense of the figures they had obtained. These were peculiar. The gravitational constant was normal. The electronic charge was normal, as was Plank's constant. The masses of the proton and the electron were as they should be, as was almost everything else. But there was one glaring discrepancy. The velocity of light was not 3.00×10^{10} centimeters per second, but 2.24×10^{10} centimeters per second, and all secondary constants depending on the velocity of light were altered in the same ratio.

Jimmy scratched his more than prominent nose, folded his six foot three into a hard knot, and grunted.

Mike whistled. "So *that's* what's cuckoo! That's why the colors were all haywire!"

"Yes, that's it. Light travels slower inside the blister than outside it. And the frequency of light waves is, of course, the same, since that depends on the source of the light and not on the transmitting medium. So as a result, the wave length is shorter. Light that would be bright-red outside is green or blue inside, and anything that would be green or blue or violet normally shows up as just plain ultra-violet. A most unpleasant situation!"

"I'll say it's unpleasant!" Mike tenderly rubbed his peeling face. "Honest blue or green light changing into U V and burning the hide off me! It almost killed one of the assistants, too."

"That's what'll happen to everybody if we can't stop the thing. They'll all be killed by overdoses of sunburn. Either that, or they'll have to stay underground or indoors whenever the sun is out. That might be possible, but it wouldn't be much fun."

"They'll die, anyway. Figure it out for yourself. It's already killed every insect that's entered the blister, and it hasn't helped some of the vegetation. A little UV helps plants and animals both, but you can get an overdose of it! And without some pollenizing insects, not to mention the plants they gotta pollenize, we're all going to starve to death. Juicy prospect!"

THERE WAS a long silence, and then the red-headed physicist asked, "Have you a ghost of an idea what it's about? How did it get that way?"

"Well, it seems fairly obvious that space itself is different inside the blister. How it got that way—Heaven alone knows, and won't tell! The same remark holds for the way it's spreading. What's the final rate, by the way?"

"They just got it figured out to about nineteen decimals. The radius of the blister, which is apparently spherical, is increasing at exactly 1.0037 centimeters per second. Rate's quite constant, too, and hasn't varied since the measurements started."

"That's some comfort. It'll take a long time to cover all of Alaska, and it won't be here in the next couple of days, at least."

Mike grinned. "Perhaps, then, the gigantic intellect before me will be able to do something about it in time," he remarked. "You really oughta do something useful once in a while. Why don't you try it? If you don't do something to live up to all those nice, shiny medals they gave you the other day, they may get onto you!"

"There may be something in what the worm says. 'Out of the mouths of babes', and so on. What did you do with your medals, by the way? Hock them and spend the money on beer?"

"No, genius, not on beer. I make the observatory pay for that. I had a better use for it. Maybe I'll introduce you to her some day."

"I shouldn't recommend it. *You* know who's the better man around here. But to get down to more mundane topics. Give the librarian a buzz and have him send up the latest dozen or so works on tensor analysis, Reinmann functions, space constants, and the way the universe is built. You know the stuff I want. Stir yourself—if possible!"

"Possible, but not probable," remarked Mike, strolling over to the communicator. "Just like your getting a useful idea!"

WHEN THE BOOKS arrived Carter and Poggenpohl arranged them conveniently at hand, slid up the huge integraph, and started work. The machine whirred and clicked, uncannily solving the equations that were fed into it. For almost forty hours, until they were drooping with exhaustion, the two men worked—pressing buttons, turning dials, making notes, always getting more and more incredible equations out of their mechanical colleague. It was midnight of the 22nd of September when they slid their chairs back from the integraph and reached for the last of the black coffee. The machine had answered their questions.

Space was not unique. There were an infinite number of possible types of space, each one with its own complete and consistent set of physical laws.

"And there we are, Mike. This freak space—let's call it para space for the present, as opposed to the ortho space we're used to—is just like ours *except* for the velocity of light, which is just 0.748 times the velocity of light here. I suppose you noticed that value?"

"Yeah. Involves two mathematical—not physical—constants. It's equal to $(e/\pi)^2$.* Gotta be mathematical constants, of course, since the physical constants may be different in the different sorts of space."

"Obviously. And there seem to be possible types of space with the velocity of light changed by that ratio, to every even power from minus infinity to plus infinity. For instance, $(e/\pi)^0$—that's our own ortho space—or $(e/\pi)^2$—that's this para space—or $(e/\pi)^{-2}$, or what have you. The limits are $(e/\pi)^{\infty}$, where light would have just zero velocity, and $(e/\pi)^{-\infty}$, where it would have infinite velocity. In that sort of a space, by the way, Einstein's laws would be just the same as Newton's, and there wouldn't be any limit to the velocity any body might attain."

"Amusing, but not very relevant. It's queer, though, that the odd types of space can't exist—like $(e/\pi)^1$ and $(e/\pi)^3$, and so on. If that tin genius of ours hasn't gone nuts, or got a cockroach in his gears, a space of that type would immediately split into the two even ones on each side of it. And then the more stable of those would eat up the other one. Those stability relations are interesting, too."

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* e is the base of the natural system of logarithms, 2.71828. π is the ratio of the circumference to the diameter of a circle, 3.14159.

"Very. The higher the exponent, the more stable the space. Thus, ortho space, $(e/m)^0$, is less stable than para or $(e/m)^2$ space, and takes less energy to maintain or form. That's why the para space is eating up our ortho space, since Quintana's machine went bad and gave it a start. And that's why it'll never stop by itself."

"Hell! That's not the worst of it! Look at equation 96-Q! Do you get the significance of that!"

Carter scrabbled through the mass of papers, studied a moment, and then turned white. "My Lord! Mike! Let's get this thing translated into time!" He swung around, and the integrator again clicked and purred for a moment. "And so that's our sentence," he remarked calmly. "At 12.02.36 p.m., on October 5th, the blister will be almost 22,000 meters in diameter, and will suddenly change its rate of growth. Instead of growing slowly and steadily as it is now, it will start growing at a much greater and ever-accelerating rate, so that it won't take more than a week to cover the earth, instead of taking years to do it, as it would if it had stuck to the old rate. It has to be stopped before noon on the 5th then, if it's going to be stopped at all."

THERE WAS a long silence. Then Mike spoke slowly, as though he were feeling his way through a problem. "Here's an idea. It's probably cuckoo, but Heaven knows there isn't anything to lose. Why not surround the blister with a bubble of $(e/m)^{-2}$ space? Since its exponent, -2, is less than that of ortho space, 0, it should shrink as our space eats it up, and confine the blister. It *might* work."

Jimmy stared; his mouth opened. "Mike," he said solemnly, "there are times when I almost think that you're worth the salary they're paying you. That *is* an idea. But look! -2 is less than 0, sure, but it's even farther below +2. So why wouldn't the blister eat up the protective bubble of——oh, call it meta space—as well as our ortho space?"

Mike turned and dug into the mass of papers like a terrier into a rat hole. "Here's why," he said, in sudden animation. "Look! Equation 47-G. One sort of space can only change to the *next* sort of space; it can't skip one. Change from 0 to -2, or from 2 to 0, but not from +2 to -2! It's a sort of metastable state, evidently, and the direct change is impossible! If that doesn't work, I'll eat the five-hundred-inch reflector for breakfast!"

"Right—it will. And now we'll have to do the calculations for the generator for the meta space. We haven't any time to waste! Ring the stock room and have them send us a flock of caffeine-citrate tablets. Black coffee won't be enough to keep us awake while we do this job!" And he turned back to the integrator.

The task the two men had set themselves was even more formidable than the one that had confronted them on the initial calculations. The generator had to be designed so that it would form the meta bubble all at once—*outside* of the para bubble. It would not do to start with a small bubble, because the meta space was unstable with respect to ortho space, and would naturally shrink. Therefore, it had to have its maximum size at the moment of its origin. And the power required to form it was in the order of millions of millions of horse power.

"That *is* a nuisance, Mike," Jimmy remarked, after fifty hours of sleepless calculation had shown them the amount of power necessary. "There aren't any pieces of apparatus in the world that'll handle it."

"Who cares?" asked the redhead, yawning. "They'll handle it for a thousandth of a second, maybe, and that's all you need. Let 'em blow up! We aren't

paying for them! Call that design crew and give them our calculations, and then let's get some sleep. I'm dead."

The design crew did their job, and for the next ten days the construction men worked twenty-four hours a day in and around the blister. The work had to be done. Quintana, now out of the hospital, superintended the construction of the meta-space generator in his old laboratory, and his unique knowledge of the phenomena involved was invaluable.

Power for the space generator was provided by a bank of atomic-energy generators, the like of which had never been seen on earth, and it taxed the almost infinite resources of the Bureau of Heavy Electrical Industry to provide them in time. The UV light inside the bubble, and the first snows of the Alaskan winter, were additional difficulties. Many men were badly burned on the deadly job, and several died. But the job was done. It had to be done.

All of the apparatus had to be run by remote control, and the control cabin was built on the peak of a near-by mountain, out of danger from the probable explosion, but close enough so that the blister could be observed telescopically. There were the controls of the atomic-energy generators, and of the meta-space generator which would form the twenty-four kilometer protective bubble around the blister. When it was formed, it would contract gradually until its contraction pressure equalled the expansion pressure of the blister, when the latter would be permanently confined. That was what the scientists hoped.

By 11 a.m. of the 5th of October, the work had been completed, the last workman and bystander had been removed to a safe distance, and the three scientists, Carter, Poggenpohl, and Quintana, gathered around the control board. Jimmy sat down before the keyboard and pressed the test button.

A RED LIGHT showed on the board; a bell rang. Mike's face went white, and Quintana winced as though he had been struck. "That means," Carter said quietly, "that the gamma lead to Tube 15 is open. And it also means that unless it is repaired in the next hour, we can't form the protective bubble. If it isn't formed by noon, the blister will reach the runaway stage—and, gentlemen, we shall all be dead."

Mike sprang up. "You stay here and close the switch at the right time, Jimmy. I'm going to fix little Oscar somehow."

"No!" exclaimed Quintana. "That is my responsibility. I am responsible for causing this catastrophe, and I must take the risk of making sure of the cure. Don't go, Dr. Poggenpohl. I'll do it myself."

"You know, of course, that when I close the main switch the meta generator is almost certain to explode? We couldn't build it to take the load for more than a moment, you know," Carter explained.

"Yes, I know. But I am going. I shall try to escape from the danger area before noon, but if I don't, close the switch, anyway. That blister *must* be stopped." He raised his hand in salute, and walked steadily out of the door of the cabin to his plane. He stepped in and closed the door. Mike and Jimmy saw the helicopter screws gather speed and the machine rise from the mountain peak.

"There goes a very brave man, Mike. He'll never get out alive."

"Not a chance in the world. 'Greater love hath no man——' Oh, hell! I'm getting sloppy in my old age. Gimme a cigarette!"

The two men sat beside the control board watching the racing clock, and glancing anxiously toward the north, hoping against hope to see Quintana's plane returning. But no racing speck showed against the iridescent blister.

11:50. Jimmy swung around and faced the board. His long fingers played over the keys. Miles away relays clicked and the atomic-energy generators purred and then roared as they warmed up. He touched other keys, and more relays clicked, as the coordinates of the meta bubble were set up. Then he waited again. "Any sign of him yet, Mike?"

"No. Nothing. Five minutes to go."

The hands of the chronometer came closer and closer together. Mike shivered and yawned a little. It was a matter of seconds now until the dead line. He started to count aloud. "Thirty—twenty—fifteen—ten—five—four—three—two—one—mark!"

CARTER pressed the red key in the middle of the board. Relays thudded and transformers hummed. The distant atomic generators grunted under an insane overload. Then circuit breakers flashed open, fuses blew like firecrackers, and miles away, at the center of the blister, they saw a blinding, white flash. "Down!" yelled Carter. "Open your mouth and plug your ears!"

They threw themselves to the floor of the control room, with their hands over their ears. And then the sound of the explosion arrived, a compression wave in the atmosphere that would have knocked them flat and shattered their eardrums had they not expected it. Groggy and shaken, they came to their feet, staggered toward the hangar, where their plane had been protected from the blast. The blister loomed up ahead of them as they headed north, but it did not look the same. Instead of its greenish iridescence, it showed a shimmering pink. The plane came to a sudden stop. The men raced toward the shimmering wall.

Inside it, they stopped, staring. Meta space was as peculiar in its properties as was para space. The sky was orange; the few stems of grass not covered by the snow were a bright-red; and Mike's hair, only reflecting infrared now, was jet-black. But they were not interested in the abnormalities of the spectrum. Ten minutes' measurements showed that neither the para blister nor the meta bubble were moving. They had approached each other to within a few hundred yards, where equilibrium had been established. The danger was over.

They flew toward Quintana's laboratory, passing over the shattered fragments of his plane on the way. The laboratory was a mass of scorched and blistered wreckage. When they traced the gamma lead they found that it had broken next to the inlet leading to the generator itself. And at the break there was what had once been a man—shattered, scorched, scarcely recognizable as a human body. But Quintana's charred hands still clasped the cable, holding it in the socket from which it had broken. There had been no way of repairing the break, and he had stood there holding it in position—and waiting for the power to go on. How long he had waited—what he had thought of—were questions that would never be answered.

Jimmy raised a hand in a half salute, and then turned and walked back toward the waiting plane. Mike followed. There was nothing more to be said.

What are Positrons?

A Scientific Discussion

by R. D. Swisher, Ph.D.

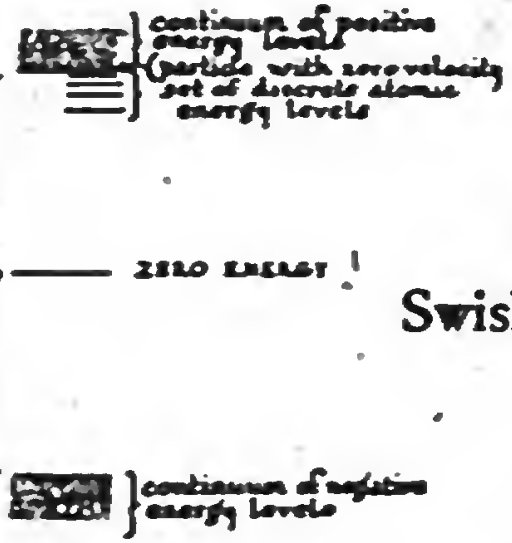


FIGURE 1.

WE know that positrons were discovered about five years ago by Anderson, that they are the positively charged twins of electrons, that they combine with electrons in an annihilation with complete destruction of matter and liberation of a corresponding amount of energy as gamma rays, and that gamma rays will sometimes undergo the reverse transition to give positrons and electrons. But behind these facts there is a story as romantic as the wildest flights of science-fiction, worthy of a place beside Adams' and Leverrier's classic prediction of the existence of the planet Neptune from irregularities in the orbit of Uranus.

The story was really unfolded about a year before the positron was discovered, but for a more complete understanding of it we must go back to the turn of the century, when things began to happen to classical physics. Mechanics had been developed, from Newton's three laws of motion, to their most generalized mathematical statement: the Hamiltonian equations.

Einstein was beginning the work which would add the last touch of refinement. Relativity was the culmination of classical mechanics, and with its aid the behavior of any system of particles could be predicted, provided you had the mathematical tools and the mathematician capable of using them. But it didn't work—not completely. You could solve problems, involving billiard balls, planets and suns, with incredible accuracy. But it wouldn't work for things as tiny as atoms.

So we have modern physics, eager to study the most important things left unstudied: atoms, molecules and electrons, and a mechanics that would work perfectly for billiard balls, planets and suns, but which proved quite inapplicable to these tiny particles. So quantum mechanics was developed, and is still being developed.

Now the prime purpose of physics, and indeed of any science, is to study observable quantities, to formulate laws which will express all experimental data, and which will allow predictions of fu-

ture events by means of these laws. Accordingly, the new mechanics must be one which will become identical with classical mechanics, if the particles are quite large, in addition to checking experiments made with atoms.

One of the most important and easily studied properties of an atom is the light that it emits. Light is an electromagnetic wave, and electromagnetic waves are formed by oscillating electric particles. In an atom we have a nucleus surrounded by electrons revolving in orbits. Since electrons are electrified particles and orbits are periodic, it was thought that the revolving electrons must be the source of the light from atoms, the frequency or wave length of the light being a function of the time of revolution of the electron.

But light emission represents energy loss, so the electron should spin in smaller and smaller orbits as it loses energy by radiation, until finally it should spiral into the nucleus. And this should take place in a very short time. Actually, each atom radiates only a few of the infinite number of possible frequencies, and those frequencies it does emit are easily measured from the spectrum. With infinite patience the spectroscopists played detective and found obscure relations between the various frequencies of the spectrum, which greatly simplified matters.

THEN Bohr brought forth the idea that in each atom there are only relatively few orbits which electrons can follow about the nucleus. A planet can revolve about a sun in an orbit at any distance from that sun, but an electron cannot have a similar freedom in choosing its orbit. Here is one near the nucleus; here is one somewhat farther out—and so on. The electron can follow any of these, but it cannot follow intermediate ones.

In the Bohr picture the electron does not produce electromagnetic waves during its revolution about the nucleus, but only when it falls from a larger orbit to a smaller one. The energy of the electron depends on the size of its orbit about the nucleus—the greater the radius the greater the energy—so that when the electron falls from the larger to the smaller orbit it loses energy, and that lost energy is totally accounted for by the bit of radiation emitted during the process.

Conversely, if radiation of the proper energy impinges on the atom, an electron can absorb the energy of the radiation and jump to an outer orbit, thus gaining exactly the amount of energy absorbed from the radiation.

The problem was then to calculate, if possible, the permissible electron orbits of the various atoms, the energies of the electrons in those orbits, then the energy differences between the various orbits. These energy differences should correspond to the energies of the various kinds of light emitted by that particular kind of atom in its spectrum.

Hydrogen is the simplest atom, and the calculation of the possible orbits of the lone electron about its nucleus agreed almost perfectly with its observed spectrum. More complex atoms did not agree so well, but it was certain that here was a new method of approach to atomic problems that showed signs of promise; the classical approach did not work at all.

It soon became evident that one of the troubles with the new method was that it introduced too much unobservable detail in the atom's workings. We spoke of electron orbits about the nucleus, and for the complex atoms even the position of the electron in its orbit must be introduced. These are things that we probably cannot hope to observe, and so are undesirable. (They are, however, very convenient in getting an approximate mental picture of things, a procedure indispensable to all of us

except those geniuses who can grasp the mathematical equations directly).

Since the orbits represent different energies of the electrons in them, we can think of the orbits as energy levels, and mentally note that the orbit is a rather crude picture of an energy level, not necessarily exact. The problem has now resolved itself into finding some sort of equations or mechanics which will enable us to calculate these energy levels of the various atoms, and the differences between these energy levels must check the observed spectra of those atoms, if the mechanics are any good.

One answer to the problem was the wave mechanics. It was discovered that electrons exhibited certain properties of waves, i. *e.*, they produced diffraction patterns. Later it was shown that protons likewise behaved somewhat like waves. The wave lengths of these matter waves are easily measured from the diffraction pattern, and an intimate connection was found between the wave lengths and the momentum of the particle in question. So here we have the two fundamental particles of matter exhibiting properties of waves, where the momentum of the particle corresponds to the length of the wave.

Obviously, the next step is to use the mathematics of waves to apply to the particles, using the observed relations between momentum and wave length, and see if it works. Wave equations must be developed in which we can substitute positions and velocities of particles, as well as the force fields acting upon them, and which on solving will give positions and velocities of the particles at some later time.

FOR VARIOUS REASONS our answers will not be exact, but—in terms of probabilities—we will find the most probable values for position and velocity of the particle at the future time. This is an inherent property of wave mathematics, and it is not too disappointing, since experiment indicates that this is actually the case with particles. So we must find some property of waves which will correspond to probability, just as wave length corresponds to momentum.

In order for the thing to have sense, this probability function must have three properties: first, it must always be positive or zero, since a negative probability has no physical meaning; second, the integral of the probability over all space must be independent of time, which is merely a mathematical way of saying that if the particle is somewhere in space now, it must still be *somewhere* in space at any later time; third, this integral of the probability over all space must be invariant with change of velocity of the observer, which means that if you observe that the particle is somewhere in space, then a person in a laboratory moving with respect to yours must also observe it *somewhere* in space. This last condition is required if relativity is to be satisfied.

All three of these conditions must be fulfilled if the concept of probability is to have any definite meaning, but we can get an approximate solution if only the first two are met, just as the laws of Newton are approximately correct for everyday use. Such an equation was developed by Schrödinger. It worked beautifully, except that the mathematics were so complicated as to preclude exact solutions in most cases. Approximations were necessary. But approximations can be made to almost any desired degree of accuracy, if you want to work long enough. The important part was that it *did* work, except for cases where relativity corrections became important.

The problem of developing an equation or set of equations in which the probability would fulfill all three of the above conditions was finally solved by Dirac. It was shown, however, that the

only possible way to meet the three conditions involved the introduction of the concept of negative energy levels, and this was very embarrassing, because the concept of negative energy was apparently foolish.

Let us go back to energy levels for a moment. In an atom we pointed out that there are only certain possible energy levels that an electron can occupy, and that the electron tends to fall to a lower energy level when it can, *i. e.*, when there is a lower one that is not already occupied by another electron. In so doing it emits a quantum of electromagnetic radiation (light, infra-red, ultra-violet, X rays, etc.) with the frequency of the radiation depending on the difference in energy of the two energy levels.

But, in general, an electron does not have to be in an atom. If we have a free electron with plenty of room, its energy, or, more specifically its kinetic energy, is measured by its mass and velocity: K.E. $= \frac{1}{2} MV^2$. If the electron is standing still its V is zero, so its kinetic energy is zero. But it still has other energy, as pointed out by Einstein—the energy of its mass, which is the mass multiplied by the square of the velocity of light, so the total energy of the free particle is (approximately, at least): $E = MC^2 + \frac{1}{2} MV^2$, where C is the velocity of light.

Since the velocity enters as a square, it makes no difference whether V is positive or negative (to right or to left), V^2 is always positive; so the energy is always positive. Also, if the electron has plenty of room to move around, it can have any velocity, and so any energy above MC^2. This means that the energy levels of the free electrons are not discontinuous, as in an atom, but a continuous series.

Now, if an electron is in a negative energy level it must behave as if it has negative mass (since negative velocity squared is still positive). That means that the more you push it in one direction, the faster it goes in the other direction. Its momentum is directed opposite to its velocity. Such particles have never been observed.

Furthermore, if you have an infinite number of these negative energy levels (just as there are an infinite number of positive energy levels) electrons should drop into them, just as in an atom they drop to unfilled lower levels, and in so doing should emit electromagnetic radiation corresponding to the energy difference. This energy difference is at least $2 MC^2$ (see Fig 1), so the radiation should be very powerful, in fact, gamma rays.

Conversely, if we did have an electron in a negative energy level, gamma rays shining on it should lift it to a positive energy level, just as happens to atomic electrons when the proper light hits them.

SO the Dirac theory requires the existence of the negative energy levels; yet they have never been observed. If there were such levels the electrons in ordinary positive levels should fall into them, and then exhibit the queer properties of negative mass. The difficulties are obvious. But the Dirac theory proved its worth by giving correct answers to some problems that the non-relativistic Schrödinger theory could not attack; so it must be kept, if possible.

Dirac surmounted the obstacle with a stroke of genius, by postulating that the very necessary negative energy levels were all filled with electrons—an infinite number of electrons, since there are an infinite number of the levels—and that this infinite continuum of negative energy electrons is synonymous with what we call empty space. This avoids the difficulty of having positive energy electrons fall to the negative energy levels, since those levels are all filled.

However, a gamma ray should be able to excite an electron in a negative level to a positive level, just as light causes atomic electrons to jump to higher levels. When this happens the excited electron becomes observable, since it has positive energy. But now we have an unfilled level in the negative energy states, and that, too, should be observable. This unfilled level, or "Dirac hole," as it is called, is, in effect, the *absence* of a particle of negative mass and of negative charge; in other words, it is the presence of a particle of positive mass and positive charge. A year later such particles were observed. They are called positrons.

The properties of the positron coincide exactly with the properties of the Dirac hole. Under proper conditions a quantum of gamma radiation sometimes disappears, and an electron and positron are observed to be created, the gamma quantum being destroyed. Conversely, when an electron and positron meet, they annihilate each other, and there is formed a quantum (or two quanta) of gamma radiation. Obviously, this corresponds to the falling of the electron from its positive energy level into the unfilled negative level, or hole, again filling it, erasing the discontinuity, and once again making "empty space."

Thus, in our particular region of space, at least, we have an infinite number of electrons filling the negative energy levels completely, this complete continuity making them unobservable and definable as nothingness. In addition to these, there are a number of electrons left over after the negative states are all filled, which, accordingly, must occupy various positive levels and be observable. These left-over electrons are what make up our atoms, along with protons—and neutrons, of course.

The question now arises: *why* are these extra electrons? Somehow it disturbs our sense of symmetry. Accordingly, speculations have been made that perhaps in distant regions of space there are vacancies in the negative levels, Dirac holes, or positrons—whichever you prefer—equal in number to the extra electrons in our own region. The picture is perfectly symmetrical. The positrons can be considered the actual particles and electrons the holes; it makes no difference.

Then, in these hypothetical, far-off regions we have excess positrons. They may have negative protons, "negatrons," "antrons," call them what you will, with which to build up nuclei about which the positrons can form orbits to make atoms, just as our atoms are built up from electrons and nuclei made with protons. These hypothetical, inverted atoms of the far-off regions would be spectroscopically identical with our own atoms; so their presence cannot be determined if we stay on earth. However, if we should visit such regions, or if matter from there should visit us, the results would be disastrous. Our electrons would combine with their positrons, disintegrating us into a flood of gamma rays.

The Dirac theory is not valid for heavy particles such as protons, neutrons and negative protons; but it seems quite certain that protons and negative protons do not hold the same relationship to each other as positrons and electrons; the negative proton is *not* the Dirac hole of a proton. Indeed, evidence indicates that protons and negative protons would actually be repelled from each other in spite of the electrical attraction due to their opposite charges. Even so, the tremendous amount of energy resulting from annihilation of the electrons and positrons of the two kinds of matter would make travel to those remote regions very dangerous indeed without the protection of something very like Dr. Richard Ballinger Seaton's "zone of force."

FRONTIER OF

by NORMAN L. KNIGHT

Ogelthorpe gazed in fascination upon the spinning jewels—the terror in his eyes slowly ebbed away.

Part Two

THE UNKNOWN

Concluding a gripping two-part novel.

Up To Now:

Ogelthorpe, employed by Submarine Products Corporation—a company which has conquered the bottom of the sea and brought its wealth of products and minerals to the world above—meets with a serious accident when the uranium battery of his diving armor cracks while he is at his work as chief of the Pest Eradication Section.

While still unconscious, Ogelthorpe is taken to the hospital, where he is put under the influence of the Sleep. Dr. Feng, working from a photograph, grafts new skin over the areas that had burned away. Dr. Carmoda operates on his eyes.

When released from the lethargy of the Sleep, Ogelthorpe says his name is Stephen Wilkes and asks for Wainwright and Hill, his co-workers. He wants to know how he can possibly be in Havana when the Exploration Section, with which he is connected, has its base of operations at the Panama station.

Dr. Lemoyne is called in to try to explain this upsetting change of personalities. Then Sonia Hogarth, Ogelthorpe's half sister, and Lloyd Osborn, his assistant and rescuer, come to see the patient. Both claim that, in appearance, he is an exact counterpart of Ogelthorpe, although the patient claims he never heard of either of them before, and says the likeness of facial features is so pronounced because Dr. Feng made him look like Ogelthorpe.

The patient then tells of the circumstances leading up to the point where a chunk of pumice stone fell on his head and he lost consciousness.

He was aboard the "Grampus," commanded by Captain Alan McLaren. They were echo-sounding around Indefatigable Island—which is a volcanic cone. They noticed golden grains swirling around the ship. Wilkes (Ogelthorpe), Wainwright and Hill got out to investigate. They followed the golden swirl to its source—a sort of conduit made of a material like purple metal. They walked and crawled through it till they arrived at the other end. Coming out, they saw a vivid-green jungle beyond a strip of beach.

The inhabitants were small brown folk, led by a girl whose name was Shadow Flower. She informed Wilkes, Wainwright and Hill that her people had waited many generations for them. They were taken through a beautiful garden and up hundreds of steps to a crowning edifice too intricate for the ordinary imagination.

Before they could enter the building a fight started among the crater people. But Wilkes (Ogelthorpe) had had a glimpse inside. He referred to the building as a power plant.

Just then the telephone rings. It is Garvin of the Personnel Office at Panama City. He says that the "Grampus" was found riding helplessly at anchor in a fiord of Indefatigable Island and that Wilkes, Wainwright and Hill cannot be found. He asks to see the man who says he is Wilkes—and when he does declares the man could not possibly be Wilkes——

VI.

ENRAGED by what he regarded as Garvin's incomprehensible treachery, Ogelthorpe continued to behave unbecomingly for several minutes. He hurled extraordinary epithets indiscriminately at every one present,

and concluded by attempting to tear off the green band over his eyes. In this endeavor he was at once restrained by Dr. Feng—who displayed surprising strength in spite of her slenderness—and by Sonia.

"You will injure yourself most painfully," said Dr. Feng rapidly. "It is practically an artificial growth and a part of your epidermis. In due time, which will be some time this afternoon, it will slough off of its own accord. Dr. Carmoda, whose work it is, will be here then."

Ogelthorpe was persuaded to take another cup of kaffina, and its soothing effect upon him was immediate; Dr. Feng and Sonia released their grips upon his arms and wrists.

"I apologise provisionally to every one with the possible exception of Dr. Feng," announced Ogelthorpe evenly. "If I resemble Ogelthorpe, I insist that it is because I have been made to resemble him. The real Ogelthorpe will turn up sooner or later, and then we shall see what we shall see."

Dr. Feng watched him with amused, silent interest, through a haze of smoke from a freshly-lighted cigarette. Dr. Lemoyne had relapsed into apparent abstraction.

"If you will go on with your story," urged Osborn, "we may gain some clue as to where and how Wilkes might have been substituted for Ogelthorpe. You were telling of a curious structure that you discovered in the crater. You called it a 'power plant' because of something that you glimpsed inside. What was that something?"

"It was a number of things," replied Ogelthorpe. "I saw them over the heads of the fighters inside the portal, during the few moments before we were involved in the scrimmage. After that my attention was elsewhere.

"The outstanding feature of what I saw was a thing like a huge vacuum tube, a cylindrical tower of transparent material, perhaps fifty or sixty feet high and filled with a whirlwind of incandescent blue-green vapor. There were platforms and stairways about it, just as there are about a big turbine or dynamo, and upon them a number of minor combats among the crater people were in progress. Beyond this, in the background, was an enormous automatic switchboard. Little lights blinked on and off and there was a constant twinkling of lavender sparks as contact was made or broken by hundreds of relays. At the extreme edge of my view some glittering apparatus was revolving busily. Then I was in the midst of a clawing, screeching turmoil and the diaphragm of the door started to close.

"A shower of stones descended from the upper stories of the power plant as the door went shut. Several of the crater people who had defended us were struck down, and the party retired hastily down the steps to the plaza. On the steps we were joined by the crater people who had followed us from the beach. All of them were in a fury of indignation; it was not quite clear why. It was evident that there was a division of opinion among the crater people, and that was all.

"Hill now expressed an urgent desire to eat, adding that his 'insides were all run down like a battery.' But Shadow Flower had already despatched runners for food, who now returned with armloads of fruit and gourds of milk. We couldn't identify any of the fruit.

"We ate and drank seated upon the turf under the tree ferns along the edge of the plaza and watched a scattered band of crater people who stood or crouched near its center, childishly pelting the power plant with stones hurled from fiber slings. They sent their missiles several hundred feet with ease.

"An occasional brown figure was visible dodging behind the filigree screens that sheltered the balconies and bridges adorning the face of the build-

ing, and once in a while an answering stone returned the bombardment. When two of the crater people in the plaza had fallen with shattered skulls, and an inmate of the power plant had toppled headlong from one balcony to another, the business did not seem so childish.

"IN THE MIDST of his meal Wainwright stood up and declared that he preferred a complete soaking in the rain to suffocating in his coveralls, and proceeded to remove them. Hill and I did likewise. Wainwright found, to his surprise, that he was carrying a small Camden rocket pistol and two clips of cartridges at his belt. In the excitement of leaving the *Grampus* he had forgotten to remove them before donning his coveralls. We rolled the coveralls into bundles and left them at the edge of the plaza.

"In case you are unfamiliar with the weapon, I might say that the rocket pistol is used ordinarily for shooting sharks while cruising on the surface; it can't be used under water. Each bullet contains a core of compressed lithium metal which expands and vaporizes on being fired, transforming the bullet into a tiny rocket which will penetrate water for a short distance. It explodes when it hits.

"As soon as Wainwright found the pistol he watched his chance and picked a brown man off a balcony. The bullet exploded in his abdomen and blew him in two. For a time we considered attacking the defenders of the power plant with this weapon and forcing an entry, but decided to find an exit from the crater first and return later, with more equipment, for a complete investigation.

"When we finished our meal it was mid-afternoon; the rain had slackened greatly, and the clouds over the center of the crater had so thinned that a patch of blue sky was revealed and let in a shaft of sunlight. With the thinning of the clouds a notch in the crater's rim became visible directly above the power plant. We asked Shadow Flower if the way out of the crater lay through this notch, and she replied that the only way for men was through the House of the Lightning, but that we might go as we chose. She glanced toward the power plant as she spoke. I asked if *that* were what she meant by the House of the Lightning. She said that it was.

"We were puzzled then. How could we escape from the crater by entering the power plant? Finally we concluded that Shadow Flower had no conception of the outside world and could not imagine a place that was in any sense not in the crater, except the interior of the plant. We decided to climb as far as we could toward the notch before darkness came on. It appeared to be two or three miles distant, straight up the slope, and if the going was reasonably easy there was a chance of our making it before sunset.

"FORTHWITH we set out, Shadow Flower and a cluster of the deserters from the power plant following at a distance. The first mile or so was easy, as the garden continued on up the mountainside and we had merely to follow the golden pathways or climb the stairs from one ornamental terrace to another. Once we crossed a curious S-shaped bridge over what was either a canal or a long artificial lake, and once we passed through a grove of plants with great rubbery leaves—the same as were worn as aprons by the crater people—which formed an almost rainproof roof. The ground there was ankle-deep with moss, like green plush, and in several places we saw herds of goats. That explained the milk that had been brought to us.

"As we went on, the rain diminished and the clouds slowly dissolved.

"We were intensely curious about the power plant and discussed it constantly. It seemed that it must have been built recently, for what earlier age

could have produced it? How could it have been constructed so secretly? How had its materials been transported into the crater? What was its source of energy? What was it for? Who were the masters of the plant and why had they not shown themselves to us? What was the relation between the power plant and the crater people?

"We tried to question Shadow Flower, but one cannot converse satisfactorily in an unfamiliar tongue while climbing the side of a mountain, even if the path is smooth. Moreover, our pace had rendered Shadow Flower and her companions breathless.

"The sky was cloudless as the sun dipped below the lip of the crater, and the crater itself became a vast bowl of blue shadow, which we glimpsed occasionally through the fern stalks. The cliffs that flanked the notch were evidently higher than on the opposite side of the crater; they still glowed golden-red in the last rays of the sun. They towered far above us and the notch was still discouragingly remote.

"Then we came to the boundary of the garden. We found ourselves confronted by a high, glazed purple wall, presumably of the same material as the power plant. An intricate golden frieze ran along it near the top. We skirted its base for some distance in dumb disappointment and then came to a tower built into the thickness of it, with a semicircular doorway at the bottom. We entered, found a spiral stairway and quickly mounted to the top, where we came out on a flat roof surrounded by a filigree balustrade. A magnificent panorama of the blue-shadowed depths of the crater lay below us, while above——

"We looked once at those terrible slopes that rose above us and gave up all hope of leaving the crater by that route. It was a chaos of crags and clinkers, needle-pointed spires, knife-edged cinders, splintered cliffs and jagged chasms. The oblique beams of the sun threw every detail into merciless relief. In a word, they were exactly like the other outer slopes of the crater, which was no more than we should have expected.

"To attempt to climb those slopes would have been like crawling up a colossal slag heap bristling with bayonets and razor blades. Before we had gone a hundred feet we would have been bleeding from as many wounds.

"The wall, I took it, was to keep rock débris from rolling down into the garden. But what titanic engineering had cleared and planted the garden, built the wall and the power plant, and bored a tunnel down into the sea?

"Shadow Flower and the others came panting up the steps and sank exhausted upon the roof. We turned hopelessly away from the tumbled slopes of lava and leaned silently upon the balustrade overlooking the crater. The swift equatorial night fell upon us and the stars came out. Down in the crater was velvet blackness. Little remote sounds rose out of it with crystal clarity: the bleating of goats, the voices and laughter of the crater people, and a growing volume of insect chirping and clicking. The air grew cooler.

"THEN we saw the lights. Hill saw them first. They may have been visible since the oncoming of darkness but had escaped our notice because of their faintness. They were spaced at regular intervals all around the crater a short distance below the rim and were vague columns of bluish luminosity, like brush discharges of electricity seen in the dark. In fact, I believe now that that is what they were. Occasionally they flickered in unison, and twice we saw a glimmering streamer of blue leap across the crater from one light to another.

"The ragged teeth of the opposite rim of the crater became suffused with a vaporous, silvery glow, as the moon swam up into the sky behind us. When

the moonlight had crept down the slope to the enigmatic lights it extinguished them by its greater intensity. In their place we dimly beheld a row of erect, tapering black towers. Later, when the moon was still higher and illuminated the whole crater, we could see that the latter was encircled by a great ring of these solid black obelisks set high upon the lava slopes.

"We asked Shadow Flower about the towers. Her answer was that the lightning lived in them and came down into the House of the Lightning when the keepers of the lightning commanded it.

"'We're going to the bottom of this thing here and now,' Wainwright declared; and then to Shadow Flower, 'Who are these keepers of the lightning?'

"'We are,' calmly replied Shadow Flower. 'We who wear the five blue stones.'

"Now I can't give you all our conversation as it occurred. It was very difficult going. We made Shadow Flower repeat the obscure portions several times, to make sure of her meaning. She said that the power plant, and the garden, and so forth, were the work of great ones from the sky, who came down inside of a big fish made of silver, with a tail of blue fire."

"That sounds like a dirigible with a rocket motor," remarked Osborn.

"That's what we thought at first, but just wait," replied Ogelthorpe. "She said that this had occurred a very long time ago, a longer time ago than she had definite words to express. We asked her what these great ones were like. She maintained that they were surrounded by a glory like the sun, so that no one could look at them."

"Men in armor," suggested Osborn. "Spanish conquistadors. The simple brilliance of polished steel magnified by generations of story-tellers into a blinding glory."

"And the power plant, was it built by these worthies armed with matchlock blunderbusses?" queried Dr. Feng with a faint note of derision.

"Exactly," agreed Ogelthorpe. "It couldn't have been. And Shadow Flower said that according to the story one could sometimes look upon the great ones by regarding their reflections in the lake when they walked upon the beach, and that their shapes were not the shapes of men. They had vast wings, and five eyes that were like pointed blue flames."

"THAT can be nothing but the fabulous creation of the primitive imagination, which is never satisfied with the bare facts," objected Osborn.

"I rather think that is the case," Ogelthorpe conceded. "But it doesn't answer the question. Who built the power plant? Shadow Flower said the great ones did, and made the garden, and put the crater people in it to keep it in order. Also, they selected some—the more intelligent ones, I suppose—to attend to certain simple routines about the plant. In the course of time, after the great ones had departed—Shadow Flower had no explanation of their departure—these routines evidently became rituals and the machinery was worshiped."

"And it continued to run, untended save by these flower-clad innocents, for—many generations?" cried Sonia incredulously.

"Apparently so," affirmed Ogelthorpe. "The bit that I saw through the door was still going. But now we come to another peculiar thing. Before the great ones mysteriously departed—into the sky, Shadow Flower said—they impressed upon the crater people that some day other and different great ones would come, great ones having the form of men, and that the power plant was then to pass into their hands. It was not clear how these others would come—possibly through the air, or upon the

sea, or under it. It might be any of these ways, said the great ones. When we came up out of the lake, we were it—I mean they, they who had been expected. And our coming entailed consequences.

"They were the consequences of the simple and quite human psychology of certain of the crater people who tended the power plant. They did not wish to surrender their ancient prestige. Another faction zealously insisted upon obeying the legendary command of the great ones. They fought. When we arrived at the portal of the power plant with Shadow Flower, who had been sent to welcome us and expected us to make a triumphal entry, we became the center of a small riot, as I have already described."

"Did Shadow Flower explain her references to—what did you say?—the Speaking Stone?" inquired Dr. Feng.

"Yes, in a way. But her explanation conveyed very little real information. In a chamber of the power plant, she said, was the Speaking Stone. It was a stone that spoke with the voice of the great ones. When we appeared on the beach it had said that we were they who had been expected. That's all we could learn about it. We suspected a speaking image, something not unknown in other times and places."

"And the crater people—— Did you learn how they first came to the island?" asked Sonia.

"Yes. Shadow Flower knew the legend about that also. An extremely long time ago—not long after the creation of the world was her version—her people lived on islands a great distance to the west. That probably explains the highly modified Malay dialect of the crater people. Then came red men out of the east, wearing plates and chains of gold and gorgeous feathers in great canoes with oars and sails. She called them the Incana."

"Incas!" cried Osborn. "Do you mean to intimate that the Incas once crossed to Asia in canoes?"

"No, I don't; I'm merely telling you what Shadow Flower said," retorted Ogelthorpe. "And besides, how about the Easter Islanders? They must have crossed a considerable breadth of the Pacific in canoes. Probably we should be amazed if we knew all that determined men have accomplished with primitive equipment. And these probably were canoes of more than ordinary size, war canoes, craft almost as large as Viking ships.

"AT ANY RATE, the Incana landed on the islands of the crater people in a state of great exhaustion and half starved. They were fed and cared for, and when they had recuperated they seized all the valuables in sight and carried off a number of the younger crater people as slaves. They spent a number of years cruising eastward from island to island. Then they turned northeastward, became dispersed into several parties in the wastes of the Pacific, and one party arrived at Indefatigable Island. The captives rebelled and slew the Incana. They broke up the great canoes and built shelters in the ravines of the lava.

"They led a wretched existence, eating raw fish and birds' eggs and drinking from brackish springs that then existed. They discovered a way up the outside of the crater and into its interior. In those days it rained irregularly, and there was a lake that almost dried up at times, and the beginnings of a jungle. Then came the great ones, who transformed the crater into a garden and built the power plant."

"Have you formed any theories of your own regarding it?" Sonia asked.

"Regarding the power plant? Yes, I have a tentative theory," admitted Ogelthorpe. "It has obvious faults, but it is the only even partly credible one that I can construct. It is this: The power

plant was originally an ancient temple; we won't attempt to imagine who built it. Very recently—say within the last fifty years—some one has installed the modern apparatus which it contains, apparatus whose nature and purpose is a mystery—save that it is electrical, and may involve transmutation processes, since it apparently evolves gold as a by-product. This person—or these persons, as it may be—is or are somewhere in a secret chamber of the plant, masquerading as a sort of oracle of Delphos and communicating with the crater people through this Speaking Stone thing. That completes my theory."

"But why should they have built it in expectation of giving it to some one else? And how could fifty years or less be considered as many generations? And why——"

"Did you ask Shadow Flower about the way out of the crater that she said could be reached via the power plant?" Dr. Feng interrupted.

"Yes, we cleared up that point, also," Ogelthorpe responded. "She described it as simply a tunnel that came out high up on the outside of the crater and the only route by which a human being could get out. The ancient way by which the crater people came in seems to exist no longer. Shadow Flower was under the impression that we were something more than human and could fly out over the top of the crater in a cloud of smoke and a clap of thunder, if we chose to do so."

"BY THE TIME we had extracted this last bit of information from Shadow Flower the moon was high in the heavens and the crater was flooded with its brilliance. From our tower we could see everything in it: the shattered rim and the chaotic upper slopes; the sentinel ring of black obelisks; the wall with its equidistant towers encircling the garden; the fern groves of the garden, all woolly and tufted in the moonlight, filling the cup of the crater below the wall; little domes and cupolas rising pallidly among the tree ferns; the lake glinting like liquid silver far below; a thin stratum of mist like a film of gauze hanging halfway between us and the lake; the dark, glistening mass of the power plant.

"A remote clamor of shouts and an occasional scream seemed to be scattered around the latter. The stone slingers were still carrying on their siege.

"As soon as we realized that our only hope of escape depended on forcing an entry to the plant, we evolved a plan. We would go down and order the besiegers to retire for two or three hours. When the occupants of the plant had become convinced that the attack was over and had relaxed their vigilance, Hill and I would attempt to climb to the most accessible balcony or window, enter the plant armed with our electric lances, compel some one to open the door for us or open it ourselves if we could, and let Wainwright in.

"Wainwright was to watch from a distance while we climbed, and pick off with his pistol any one who might try to halt our ascent with a few well-aimed stones. Wainwright was the best shot of the three of us, and it was evident that whoever scaled the walls of the power plant could not wield a pistol effectively while doing so.

"Our return down the mountain was like an experience in a dream. The intense moonlight shed an unreality over the garden, over its pools and pergolas, its stairways and fountains. Numberless night-blooming flowers had opened and the air swam with their fragrance. Little bands of crater people ran laughing through the moon-flecked shadows, some crowned with great inverted single blossoms, like grotesque hoods. Halfway down we halted under a little shelter with a bulbous, mosquelike dome, and our escort found and brought us fruit and milk.

"When we arrived at the plaza we found the attacking stone slingers considerably augmented in number. After a prolonged parley we managed to convey our plan and they reluctantly dispersed. As we were all dead for want of sleep, we decided to take a swim in the lake and turn in for a couple of hours or so, leaving word with the crater people to waken us when the moon was halfway between its present position and the crater's rim.

"It occurred to Wainwright that it would be pleasant to smoke after we swam and that furthermore there was a pack of cigarettes in the pocket of his coveralls. We went to the place where we had left our coveralls and behold! they were gone.

"Some of the stone slingers who still lingered near the plaza volunteered an explanation. Men from the power plant, they said, had 'come up out of the ground,' seized our coveralls, and disappeared whence they came. This strange assertion was clarified when we were shown a sort of round manhole cover near the edge of the plaza. It was of the same metallic purple material as the plaza itself, fitted flush with it and almost air-tight. The point of a needle could scarcely have been inserted in the crevice around it.

"The crater people all joined in believing that the object of this theft was to make 'bad magic' against us. Some article of our personal belongings was considered necessary for this purpose.

"AT ANY RATE we had to forego our smoke, but we could still have our swim. We went down to the beach and tried to persuade the crater people to leave us. That is, Hill and I did. Wainwright is one of these perfectly poised types who would not be confused if he were to step out of his bath and find his apartment full of friends who had dropped in unexpectedly. But Hill and I still felt a certain old-fashioned reticence about undressing before a mixed crowd of spectators—even sketchily-clothed barbarian spectators. Also, it offended our dignity.

"Wainwright stood by and chuckled while we commanded our retinue to follow us no farther. After we had assured them that they would find us asleep in plain view on the beach when it was time to awaken us, they retreated and we continued in the opposite direction.

"We came to a rounded ridge of stone that cut across the beach and projected into the lake. Clambering over this, we descended to the beach on the other side. Here Hill and I felt sufficiently screened to remove our clothes and plunge in. Wainwright was still laughing. We rolled up our clothes and laid them on the beach. Moved by some obscure impulse, Wainwright hung his belt and pistol on a limb in the dense shadow of a flowering shrub where beach and garden met.

"After wading in up to our chins, we struck out. The water was pleasantly cool and so clear that we could see the gold dust sparkling on the bottom in the moonlight. Far up the beach a great crowd of crater people were laughing and splashing in the water. Apparently they had no fixed hours for sleep—at least during full moon.

"When we had swam about a hundred yards we halted, floated a while, and then turned shoreward.

"Suddenly Hill exclaimed, 'That ridge of stone we crossed isn't a ridge at all! It's the end of another conduit like the one we came through! Look at it!'

One look told us that Hill was right. Viewed from the lake, the seeming ridge was revealed as the curved back of a great, half-buried tube. We were looking directly into its circular orifice, like the muzzle of a huge gun, and it seemed to me that a little light gleamed and vanished in the depths of its black throat. The rim glinted purple under

the moon and a veil of blooming creepers had draped itself across the upper half of the opening, whose lower edge dipped under the surface of the water. It was Wainwright's opinion that it was an abandoned drain from the power plant and that the gold-laden water had once discharged into the lake.

"BY THIS TIME we were near the beach and an alarming fact became evident. At any rate, it alarmed Hill and me. Our clothes were gone!

"We floundered through the shallows in a feverish hurry, Wainwright following quickly but calmly. We darted hither and thither among the ferns and shrubs along the beach, thinking that the crater people might merely have moved our clothes, but found nothing. Wainwright went at once to the shrub where he had hung the belt and pistol and there they were! Forthwith he commenced to laugh again. What did clothes matter, he said, when a good weapon was in our possession? Mere clothes would not force a way into the power plant.

"I thought of the fugitive light I had seen in the abandoned conduit and asked the others if they had seen it. They had. We agreed that our clothes had vanished thither to assist our coveralls in making 'bad magic.' Hill cried in an outraged voice that the 'bad magic' was already working and could scarcely be much worse.

"'Do you expect Wilkes and I to parade across that plaza and up several score of steps, in strong moonlight, with a whole tribe of these people looking on, like *this!*' he stormed. 'No! I don't care if we never get out of here if it depends on that!'

"'What are you going to do then? Become a wild man of the woods?' Wainwright laughed. 'And besides, in the first place, we won't attack from the plaza but from the side, where there is plenty of vegetation to cover our approach. In the second place, there are millions of leaves available. Pick yourself a suit of clothes. It's being done in this crater.'

"That struck us as a sound idea and the great leaf hunt was on. Most annoyingly, we could find nothing but small leaves at first. We tried plaiting the stems together and produced kilts of sorts, but they were very untrustworthy and fell apart at the first move. Wainwright sat on the beach uttering guffaws and ribaldry. We could have strangled him.

"We found some large, broad leaves that seemed quite promising, but they tore like wet paper. Hill cursed the power plant, the crater people, the Galapagos Islands, and Submarine Products in five languages.

"Then we came upon some of the big rubbery leaves of the sort that clothed the crater people. There were long, tough fibers in the stems from which we fashioned stout girdles about our waists. When Wainwright saw how simple it was he put on his pistol belt, attached two leaves to it, made himself a crown of flowers, and said he was prepared for anything.

"I MUST HAVE fallen asleep as soon as I stretched myself on the beach, because it seemed only a moment until Wainwright was shaking me. The moon was halfway down the sky to the crater's rim and the crowd of bathers up the beach had dwindled; only three or four voices were still audible.

"The crater people who had come to awaken us stood near. They were plainly astonished by our change in costume, and one individual was so overcome by curiosity that he asked us the reason thereof. (We interpreted his name as Deep Water Surrounded by Trees, but shortened it to Deep Water for convenience among ourselves.) When we described the disappearance

of our clothes there was much indignation and nodding of heads.

"Shadow Flower and Deep Water volunteered to show us the least difficult place to climb into the power plant, while the rest circled the building and set up a disturbance at the point most distant from where we would attempt to enter.

"First we retrieved our lances from our armor, where it lay on the beach. Then, accompanied only by Shadow Flower and Deep Water, we followed the garden paths of sparkling sand for a while and finally turned aside into the fern thickets.

"I was only half awake and everything seemed more unreal than ever. We crept from moonlight to shadow, from shadow to moonlight. And the moonlight was wonderful—more like diluted, greenish sunshine than the light of the moon. The garden round about was a labyrinth of moonshine and heavy black shadow lace, all set with enormous night-blooming flowers. The air reeled with fragrance; breathing it was like inhaling vaporized honey; if such a thing were possible. The only sounds were the piercing voices of millions of insects—whirring, buzzing, chirping, grating, clicking, tinkling.

"Hill didn't have a crown, but I did; Shadow Flower wove one as we went along and made me wear it. This plainly displeased Deep Water. I could not avoid seeing that he was jealous, any more than I could continue to misunderstand the timid advances of Shadow Flower.

"At last we made our stealthy way through a grove of the giant tree ferns. On the deep moss under them lay dozens of the stone slingers, alert but silent. Beyond the grove lay a narrow lawn carpeted solidly with minute, pale blossoms, and beyond that the side wall of the power plant rose like a fantastic sculptured cliff in the moonlight.

"At regular intervals, from the midst of this lawn, great trellis-work girders, or rather columns of filigree, upreared themselves in majestic parabolic curves that terminated against the wall of the power plant at a height of about one hundred and fifty feet. An elaborate semicircular balcony, somewhat like a proscenium box, projected on either side of these points where the curved columns terminated. Deep Water advised that Hill and I climb one of these columns, drop off on a balcony and enter. He kept his eyes on the ground as he spoke; but I ascribed that to mere jealous sulking.

"The ascent of the column was easy. It was actually a tube or cylinder of intricate metallic filigree about ten feet in diameter. The design of the filigree was on such a scale that we crawled through its interstices and climbed inside of the column. There were cross-beams and platforms of grid work at intervals, on which we could pause and rest. The flowering plant that covered the lawn was, in fact, a creeper which also swarmed up the column to its very summit and veiled our movements within. While we were traversing the almost horizontal portion at the top of the curve, one hundred and fifty feet above the ground, we moved cautiously to avoid falling through the filigree.

"WE CAME to the top of the column. On either hand was a balcony slightly below our level. We saw with relief that both were deserted, as were all the other balconies that we could see. From each a tall, elliptical doorway led into the black mystery of the interior. Warily, I thrust my head through the screening creepers and let my eyes rove up the face of the building. They halted, almost with a jar, on an object about fifty feet above. For a moment I was rigid with horror. A monstrous something, a cross between a pterodactyl and the Gorgon Medusa, was leaning out

over a ledge and fixedly returning my stare with three eyes like fire opals.

"Then I saw it for what it was: an architectural detail like a gargoyle on a cathedral. There were more of them—a long row equally spaced—as far as my view extended. But there was something else beside it, creeping out from behind it: a crater man with five blue stones sparkling in his metal headband! Poised on one hand was a chunk of rock twice the size of his head. Even as I attempted to dodge I wondered how he could lift it so easily. Then it was coming down upon me and I discovered that I could not withdraw my head inside the column! My left arm and shoulder were entangled with the tough creepers!

"The stone struck the filigree within six inches of my ear, bounced off, hit the balcony balustrade, shattered into several pieces, and hurtled downward. It seemed as light as cork and quite brittle. Pumice stone! Plenty of it in the crater, no doubt.

"But before the stone hit the balcony, a hissing meteor trail of metallic vapor flashed past me, impinged on the crater man, and exploded violently in a flash of crimson fire. The gargoyle's head fell off and crashed down on the balcony. Then I heard the belated crack of Wainwright's pistol far below.

"Another crater man appeared. They must have been watching us from the time we emerged from the ferns. I was still struggling to free my arm. He hurled another massive chunk of pumice stone. Another rocket bullet hissed upward, a volley of small stones clattered against the wall; the pumice stone whacked against the side of my head and the universe collapsed."

"AND THEN——" prompted Dr. Feng.

"Then I found myself stretched out on my back, all numb and cold, with this thing over my eyes," replied Ogelthorpe. "I heard you addressing me as 'Mr. Ogelthorpe' and telling me not to be alarmed. But this is what I want to know: What happened to Wainwright and Hill? Where are they now?"

"They are probably in the crater of Indefatigable, if what you have told us is a narrative of fact," replied Osborn. "Assuming that it is, the thing to do is to notify Garvin."

Osborn at once proceeded to get Garvin on the telephone.

"This is Osborn," he announced, when the connection had been made. "I may have a clue to the whereabouts of your three missing men."

"You mean two. I'm not missing; I'm here," reminded Ogelthorpe.

"You don't say! Where do you think they are?"

"Why—er—in the crater of Indefatigable Island. Ogelthorpe seems to have acquired information, in some weird fashion, that they *were* there four or five days ago."

"Sink me for a derelict! How could he know that? That's where I think they are myself!"

"Where two of them are, you mean," muttered Ogelthorpe.

"Why do you think that?" demanded Osborn.

"I've just had another conversation with the Albemarle Island outfit. Last night they made a flight over Indefatigable in a drig. It seems they couldn't in the daytime on account of a rain cloud which forms over the crater then, but disappears at night. Even at night the air over the crater is so turbulent that they wouldn't risk descending into it for fear of being swept against its walls. But they saw plenty. The moon was almost full and they dropped a parachute flare. The inside of the crater is a jungle with a lake at the bottom. With their glasses they saw a number of people on the lake beach; most of them were dark-skinned primitives, but three

of them were apparently white and much taller."

"Three! *Three!*" cried Ogelthorpe.

"The three white men waved at the drig," went on Garvin. "Two of them were practically naked, save for some sort of leaf drapery; the third was in diving armor. Sounds silly, but that's what I was told. They must be our men, because there is no other expedition in the Islands. Moreover, the crew of the drig claim that they recognized Wilkes as one of the three by his dark hair and several days' growth of beard. Wainwright and Hill are depilated. So you see——"

"Stop! Sign off! That's impossible!" interrupted Ogelthorpe. "I'm here! I'm not in the Galapagos!"

"I hear your friend Ogelthorpe again, Osborn," said Garvin. "I seem to excite him unduly so I shall say nothing further—except to remark that we have verified Captain McLaren's report of a heavy submarine precipitation of gold dust somewhere near Indefatigable. The *Dolphin* ran through the edge of it this morning. And they're still flushing gold dust out of the *Grampus'* turbine tubes. Good-by."

"It seems that Ogelthorpe's story stands verified in several essential points," remarked Osborn to the room at large. "Although I can scarcely believe——"

"I believe that it all really happened," declared Sonia.

"I am very much puzzled," murmured Dr. Feng.

"It did happen, just as Ogelthorpe—or rather Wilkes—has told us," announced Dr. Lemoyne, suddenly breaking his long silence.

"Ha! Some one believes me!" exulted Ogelthorpe.

"How do you know that?" demanded Osborn of Dr. Lemoyne.

"Let us not go into that question now," Dr. Lemoyne requested. "In a few hours our friend's eyes will be uncovered. Wilkes' photographs should have come down from New York by then. If you, Hogarth and Osborn, will come with me I shall determine the exact time at which you should return. Then we shall see."

VII.

DURING the afternoon Ogelthorpe spent half an hour in the hands of Dr. Carmoda, the opthalmic surgeon, and was then returned to his room. The band of green membrane had been removed and he had learned, to his astonishment, that his own eyes had been irreparably damaged by the battery fluid, and that the eyes through which he would henceforth look upon the world had been transplanted from another individual, the victim of an industrial accident.

In addition to Ogelthorpe and the interne, Matsuda, who had transported him to and from the operating room, there were present Dr. Lemoyne, Sonia, and Osborn. Dr. Feng was absent, her peculiar talents being required by a case of millaluan-ray burns.

"Slowly I am ferreting out the facts," grumbled Ogelthorpe, as the interne assisted him into the cushioned chair beside the bed. "You have changed my name, shaved my head, remodeled my face, and given me another man's eyes. What next?"

"I shall immediately exert every effort to discover what is next." Dr. Lemoyne smiled as he set up on a tripod an object somewhat resembling a camera. It was, in fact, a portable televisor, and through it, and the microphone behind Ogelthorpe's chair, Dr. Lemoyne's proceedings were closely followed by half of the Psychiatric Section and a number of students, in an auditorium on the ground floor.

"You will be interested to know that I now have photographs of both Wilkes and Ogelthorpe," Dr. Lemoyne

"Before the stone hit the balcony, a hissing meteor trail of metallic vapor flashed past me —impinged on the crater man —and exploded violently."

continued casually. "Also, that there is a full-length mirror a short distance to your right. You will have every opportunity to determine your identity."

Ogelthorpe surveyed the room, blinking. "Let me see the photographs," he requested.

"Tell us which one you believe to be of yourself," directed Dr. Lemoyne as he placed them in Ogelthorpe's hands.

"Why, this one, of course," declared Ogelthorpe without hesitation, pointing to the photograph of Wilkes. "This was taken last year after I had returned from a three months' cruise round about Tahiti; you can see I was sun-burned to a sort of mahogany color. Also I had hair on my head, as human beings are intended to have.

"This other one is Ogelthorpe, I suppose. Humph. The full face is not bad but the profile is terrible. Why didn't he have his nose remodeled? Head shaved, but you can see that his hair is reddish-brown. Mine's black. So are my eyes; but his are blue. Also, he takes a lighter coat of tan than I do. How can any one say that we resemble each other?"

"Come, I shall show you," said Dr. Lemoyne, taking his arm and assisting him to rise. "This way. Now turn to your right."

"Somehow, whenever I attempt to move I feel strange and awkward," complained Ogelthorpe. "My hands and feet don't respond exactly as I want them to. Why, by all that's unholy! There's Ogelthorpe in the next room, beyond that glass door! And you said that——"

Dr. Lemoyne arrested Ogelthorpe in mid-stride. "Stop! You cannot go through there! That is not a door, but a mirror. You are looking at your own reflection!"

"What trickery is this?" cried Ogelthorpe, his voice rising hysterically. "It is a door! Mirrors do not have hinges and handles!"

IN TWO STRIDES Ogelthorpe reached the mirror, jerked on its handle —and disclosed the interior of a small closet. The mirror did, in truth, serve as a door to the latter.

For a moment he stood rigidly in the midst of a pulsating silence. Then he slammed the door and glared feverishly at his image in the mirror.

His features slowly became pinched and white. He leaped back from the mirror, his eyes full of horror, and turned upon Dr. Lemoyne, clutching at his own throat as though he were strangling. For several seconds his jaws worked speechlessly.

"I know what you've done!" he shouted at last. "My Lord! I know what you've done! Dr. Feng, that she-devil! She transplanted my brain! Let me out of this place! I'll find her if it's the last——"

His knees sagged. Dr. Lemoyne half carried him to his chair.

"You are incoherent," Dr. Lemoyne reproved gently. "You have been reading sensational fiction. A human brain has never been transplanted. That is something still far beyond the abilities of modern surgery. I shall try to explain to you what I believe has occurred. But first you must subdue all these untrammeled emotions. Obey the instructions that I am about to give and all will be well."

While Ogelthorpe huddled in his chair, white and shaking, Dr. Lemoyne stepped quickly to a small table and picked up a curious little apparatus. It was a little box of dark metal that he held easily in the palm of his hand. Fixed upon its front was a nickel-plated wheel bearing upon its rim and spokes a geometric arrangement of silvered glass jewels.

At a pressure of the doctor's thumb a brilliant light from within the box illuminated the jeweled wheel, which commenced to revolve. Faster and faster the jewels revolved, darting out

rays and sparks of light; faster and faster, until they could no longer be seen individually, but became mere sparkling curves and spirals; faster and faster, until the curves and spirals resolved themselves into a glittering, interlacing pattern of scintillant loops of white fire.

Dr. Lemoyne's eyes were fixed intently upon Ogelthorpe's face. Ogelthorpe gazed in fascination upon the spinning jewels. The terror in his eyes slowly ebbed away.

The eyes of Sonia and Osborn were likewise riveted upon the living light pattern. It seemed impossible to look away from it. There seemed to be nothing else in the world but those loops of white fire, twining, twining, twining in——

The wheel emitted a faint musical note.

Sonia and Osborn started violently when the interne, Matsuda, tapped their shoulders.

"Pray do not watch the lights," he murmured. "Dr. Lemoyne desires to hypnotize Señor Ogelthorpe only. I advise you to observe the latter instead. He will doubtless be most interesting."

DR. LEMOYNE slowly advanced the whirling jewels until they were within a foot of Ogelthorpe's eyes; then he quickly withdrew them and substituted his own face.

"You must look at me," he said in an unhurried voice of calm authority. "Look at my eyes. You cannot look elsewhere. You can hear nothing but my voice. What I say, you will believe; and what I order, you will do. *It is true that you are Wilkes; but by some strange accident you have usurped Ogelthorpe's brain and Ogelthorpe's body.* That is unfair to Ogelthorpe. Therefore, as you came so must you go. Do you understand, Wilkes? You must go. Wilkes must go, that Ogelthorpe may return. You must go now."

Ogelthorpe seemed torn by an internal struggle. He trembled; the veins stood out on his forehead; his mouth opened and closed as though he would speak, and at last he did speak—haltingly, with his eyes fixed on Dr. Lemoyne's face.

"How—can—I—go?"

"You must think with all the force of your mind, 'I will go and Ogelthorpe shall return.' I shall think with you. You must wish to go. You *do* wish to go," replied Dr. Lemoyne. Then to Matsuda, "The ring."

Deftly, the interne encircled Ogelthorpe's head with the silver hoop. He touched a wall switch and little jets of blue light sprang forth upon the silver, pursued each other in luminous ripples round and round it. Ogelthorpe became rigid and pallid as a man of marble, his eyes rolled upward so that only the whites were visible, and it seemed that he ceased breathing.

"You must go now, Wilkes," said Dr. Lemoyne, his mouth close to Ogelthorpe's ear. "You must go now, and Ogelthorpe will return. You must go. You must go. You must go."

For several minutes there was no sound save Osborn's heavy breathing and a long, trembling sigh from Sonia. Dr. Lemoyne waited tensely with closed eyes. Matsuda, listening intently, held the stethoscope microphone against Ogelthorpe's chest and finally raised his eyes to the doctor.

"He has passed the minimum, señor," said Matsuda. "His heartbeat accelerates."

Dr. Lemoyne opened his eyes and ordered, "Remove the ring."

The wall switch clicked again under Matsuda's fingers. The dancing blue lights vanished from the silver ring. Ogelthorpe's eyes rolled down to their normal position and his eyelids drooped shut. The color flowed back into his features and he stirred slightly. Matsuda gently lifted the ring.

Ogelthorpe yawned leisurely and stretched his arms above his head, eyes

still closed. Then, abruptly, they flew open and he sat up with a jerk, as one who remembers something.

"WAINWRIGHT! Help! Come back! I'm——" he cried, checked himself, gazed blankly at the room and its occupants and exclaimed, "What's this?"

"You're in the Medical Center at Havana," explained Sonia eagerly. "You were brought here after you fell and——"

"Do you remember falling?" Osborn broke in. "We were on Diabolo Reef and——"

"Oh, *that* place!" Ogelthorpe remarked with a puzzled frown. Then, his face clearing, he said, "Oh yes, I remember that. I presume that I was somewhat damaged and have been in the Sleep since. How long?"

"About five days," replied Osborn. "You came out of it, for the first time, several hours ago."

"For the *first* time!" exclaimed Ogelthorpe wonderingly. "What do you mean? This *is* the first time, isn't it?"

"No. When you were first revived you were not yourself," Dr. Lemoyne put in. "You believed that you were another person. You insisted that your name was Wilkes."

"Wilkes? Why, how strange! I had a sort of dream about a man named Wilkes."

"You had this dream while you were endormant?"

"I suppose so. People sometimes do, don't they?"

"Frequently. But what did you dream about Wilkes?"

"Oh, a fantastic thing. Strictly speaking, I didn't dream about Wilkes; I dreamed that I was Wilkes, and yet I was myself. How shall I put it? I mean——"

"This is very interesting," said Dr. Lemoyne, seating himself on the edge of the bed so as to face Ogelthorpe. "Did the submarine *Grampus* figure in your dream?"

"How did you know that? Yes, it did. At least I heard it mentioned by two other men in my dream."

"Were their names Wainwright and Hill?"

"They were! Did I tell you all this while I was not myself, as you say?"

"You said a number of things which I would be pleased to have further elucidated. But first you must take some refreshment."

While Ogelthorpe regaled himself with a mixture of kaffina and mangora juice, Matsuda packed the ring, the televisor, and other paraphernalia in their cases and departed with them. Dr. Feng arrived, asked for and was given by Dr. Lemoyne an account of Ogelthorpe's restoration.

"Now, Señor Ogelthorpe, please commence at the beginning and tell us what you can remember of this dream, as you call it," requested Dr. Lemoyne. "It is important for scientific and possibly other reasons that you try to remember as much as possible."

"You know what happened to me," Ogelthorpe began. "An eddy swept me over the edge of Diabolo Reef and I made a forced landing. After a while I seemed to revive. I say seemed to, as it was evidently only a sort of dream or vision. But although I call this a dream it had none of the quality of a dream; while it was going on I never doubted that it was real.

"AT FIRST I thought that I was aboard the *Narwhal;* I heard voices and could feel that my armor had been removed. Also, my head throbbed fearfully, and when I touched it I found an excruciatingly sensitive lump and an area of hair matted with blood. That, I supposed, was the result of my fall.

"As my returning consciousness grew clearer I was puzzled by the discovery that I was naked save for a strange-

feeling garment around my waist. In addition to the hurried and urgent voices near by there was a distant clamor of whooping and yelling, apparently far below; and there were answering whoops and yells high in the air above. An irregular, clattering tattoo rose and fell, as of small, hard objects striking a hard surface. Then came the bang and hiss of a rocket pistol and I opened my eyes.

"I was on my back looking up at the moonlight filtering through a dark canopy of leaves and creepers that clung to a curious filigree framework. Even as I looked the rocket bullet found its mark somewhere; a crimson flash glared through the leaves; there was a detonation, shrieks, and a clangor of falling metal. I sat up.

"I was inside a big cylinder of filigree, overrun with creepers. In sitting up, I thrust my hand through an opening in the filigree under me and my arm went on through clear to the shoulder—and encountered only thin air. This brought my face close to the hole I had torn through the mat of leaves and tendrils. The ground was visible a hundred feet and more below. Sitting up again and examining the uncomfortable garment around my waist, I found that it was a kilt of large, leathery leaves!

"Two white men crouched beside me and peered through the screen of creepers. Both had leaf kilts like mine, and one wore a crown of flowers and a pistol belt. He was in the act of returning the rocket pistol to its holster, remarking that it was no use to waste any more shots that night, that his particular attack was a failure, and that they must take care of Wilkes first. Wilkes, it developed, was I.

"These other two chaps (they called each other Wainwright and Hill) then asked me if I felt equal to 'climbing down the column.' I didn't understand what they meant then. I gathered we were in a towerlike structure. But I was still under the impression that only a half hour or so ago I had fallen off the cliff on Diabolo Reef, and I couldn't see how I had gotten from there to where I was, nor what could have happened to my armor and clothes.

"I tried to tell them all this but they informed me very kindly that it would all come back to me as soon as my brain recovered from the shock of the blow. They said I had been faded out by a stone that somebody had tossed. I tried to argue about that, but they urged that I must try to go below somewhere with them as it was dangerous to stay where we were.

"THE WHOOPS and cries above and below us still continued, accompanied by the persistent fusillade of clattering impacts. Some small missile ripped through the leaves and whacked against the framework with a ringing sound, and then there was a jarring concussion overhead and leaves and rock fragments showered around us. More yells.

"Wainwright said we should start immediately as we were in the middle of No Man's Land and under fire from both sides. I wanted that explained to me but they half carried me away, and after a bit the tubular framework commenced to curve downward. They pressed me to try to hang on and climb down. I was still dizzy, but with Wainwright and Hill on either side bracing their bodies against mine as we went down, I managed to get along. Soon we were climbing vertically downward. At intervals there were platforms where we paused and rested.

"At the bottom we parted the creepers and stepped out through an opening in the filigree. All around was a solid turf of small white flowers. A magnificent full moon swam low down in the sky. The filigree column soared upward in a parabolic curve and met the face of a huge, unearthly building. The exte-

tion of the descent made my brain reel dizzily, and I fell forward among the flowers.

"I glimpsed little, dark, human figures darting here and there upon the higher ledges and projections of the edifice and heaving over great jagged stones that fell whistling and thudded into the flowery turf. Small, swarthy, naked men ran and yelled about us—their wildly-flying dark hair stuck full of flowers—and hurled pebbles from slings.

"Suddenly I felt deathly sick. A flood of blackness came pouring over me as I lay on the flowers. I felt hands lifting me, heard the voices of Wainwright and Hill, then an alarmed feminine voice speaking a strange tongue. They grew fainter and fainter, like fading radio voices. Then nothingness.

"I revived again to find myself looking at a sky filled with extraordinarily brilliant stars. There was no other light. The moon had set. Somewhere near, water lapped and gurgled softly. Some one was holding my head, upon which a cold, wet mass—of clay, it seemed—had been bound. Wainwright and Hill were near, conversing in undertones.

"I gathered that we were marooned on an island and that to escape from it we must enter the strange building I had seen, but that certain people had locked us out. It wasn't plain just how we got on the island. It seemed that we had become separated from the main body of an expedition that had come there on the submarine *Grampus*. It's odd that I should dream of that ship; Submarine Products owns a vessel by that name, but I've never seen it."

"THE STORY that you told us this morning ends where this one begins," said Dr. Feng.

"Strange that I should forget that part of it and remember this," remarked Ogelthorpe. "But to proceed. I sat up and groaned. The individual who had been holding my head vociferated unintelligibly. Wainwright and Hill asked me how I felt, calling me Wilkes. I informed them that my name was Ogelthorpe. Their reply was to call me 'poor old chap' and to tell me to compose myself and sleep it off—whatever 'it' was. I insisted on knowing where we were, and they replied that we were in the crater of an extinct volcano on Indefatigable Island in the Galapagos. They wouldn't explain how we got there. They said to wait until to-morrow.

"We went into the depths of an impenetrably dark thicket, where the ground was cushioned with resilient moss. There they made me lie down. A fourth individual—the one of the feminine voice and unintelligible speech—accompanied us. Before entering the thicket I could see dimly in the starlight that she was very small and slim, and supposed that she was a large child. But Wainwright said that she was a woman of the tribe that inhabited the crater; he called them the crater people and referred to the woman—girl, rather—as Shadow Flower.

"In the gray twilight of dawn I woke suddenly. I was lying amidst enormous ferns with one ear pressed against the ground, and could hear a faint subterranean rumbling and muttering like the first stirrings of steam in a boiler. It was probably this sound that wakened me. The other two men woke at the same time; they heard the sound also.

" 'Is this devilish volcano turning up to blow off?' exclaimed Wainwright. 'If it is, it will be all up with us—literally all up!'

"We hurried out of the thicket, I worrying with the mud pack on my bruised cranium. It had dried into a stony lump that could not be pulled off without removing half my hair with it. This gave me food for thought. My head is shaven regularly, and for my hair to have

grown as long as it had, I reasoned, a considerable time must have elapsed of which I remembered nothing.

"From the fern thicket we emerged on a beach by a sheet of water that lay as still as a plaque of dark glass under the ghostly veil of mist that hid its farther side. Towering above the mist, a ring of jagged black peaks encircled us, sharp and clear against the blue-green sky of early dawn, in which a few great stars still burned. Although I could no longer hear it, I seemed to sense with the soles of my bare feet the continued, remote, sinister growling in the depths of the earth.

"Then a new sound began and grew in volume, a sound from the air, a rustling and whispering as though vast, silken curtains were shaken in the sky. We looked upward and beheld a rippling canopy of sulphurous blue auroral streamers swiftly weaving itself high in the air. They flowed out from the surrounding peaks in undulating sheets, unrolling like scrolls, fluttering like banners, hissing softly like the rush of a myriad invisible wings.

"I was amazed to see that the leaves of the ferns, even our own bodies, were surrounded by dim, blue, palpitating auras. I felt a strange, exhilarating tingling of the skin and scalp, and a curious keen sweetness was in the air.

"SHADOW FLOWER seemed quite unconcerned; she yawned and stretched and scratched the calf of her leg. Wainwright asked her something in her own tongue and she replied languidly. She declared, Wainwright translated, that these phenomena occurred every morning. Her cryptic explanation was that 'the storm-fire awakes and spreads its wings, and the earth-fire awakes and rises from below into the house of the storm-fire.' Wainwright explained that 'storm-fire' was 'lightning,' but he could not elucidate 'earth-fire.' And meanwhile the dawn grew steadily. The easterly slopes of the ring of peaks flushed pink.

"Then still another strange thing took place. A deeper, more voluminous hissing rose distantly above the thin sibilance of the aurora. High upon the crater's slopes, but still some distance below its rim, there spouted skyward mighty jets of steam—equidistant as though from purposefully placed vents in a great circle about the crater. For several seconds they spouted, building up an enormous ring-shaped steam cloud around the crater, and ceased. But the cloud remained and miraculously grew. It grew inward, following the surges of the aurora, smothering the aurora, reducing the visible sky to a circular patch which contracted rapidly—vanished. We were in a gray twilight again.

"There was a flicker of blue lightning overhead, a muffled roll of thunder, and then rain! For a few moments it descended in torrents and then settled down to a steady drizzle.

"'So!' exclaimed Hill. 'So this is how Indefatigable's daily rain cloud begins. If there ever was an artificially induced rainfall, this is it, and I'll wager my clothes that it was manufactured in Shadow Flower's House of the Lightning.'"

"But this is preposterous!" objected Osborn. "Even if it were possible to manufacture a rainstorm, why make one in the crater of a desert island?"

"I am merely describing what I dreamed," replied Ogelthorpe. "Anything may happen in a dream. Nevertheless, I dreamed that there was a quite adequate but very remarkable explanation of the rain in the crater."

"But it wasn't a dream! We should have told you before!" cried Sonia. "Probably at this very moment men are attempting to rescue Wilkes and his two companions from the crater of Indefatigable!"

"What! How can that be? How could I——"

"Pray go on. I shall explain that to you later. Let us hear the rest of your story," urged Dr. Lemoyne.

"But if what we discovered in the power plant really exists, if it was not merely my dream, then we must find some one who—— We must search the world! It is imperative that——" cried Ogelthorpe disjointedly, in great agitation.

"Then you *did* succeed in entering the power plant?" interrupted Dr. Feng.

"Yes! And we found—— But this is incredible! Are you sure that I did not dream this? The world—all our lives—everything—will be changed!" Ogelthorpe persisted.

"I do not have the slightest doubts. But continue your narrative. Did you witness the creation of the rain more than the one time?" asked Dr. Lemoyne.

"Yes. We were there four days and the same sequence of events occurred every morning. A gentle, steady rain would continue until mid-afternoon and cease; then the clouds would melt away and the sky would be clear as a bell until next morning.

"WE SPENT the greater part of my first day under the shelter of a clump of big-leaved things like plantains. Other crater people came, bringing milk and fruit and strips of roast lizard meat, still hot, rolled up in leaves. Wainwright and Hill tried to revive my dormant memory and to convince me that I was Stephen Wilkes by recounting all that had led up to our arrival in the crater. They said——"

Here Ogelthorpe practically repeated what he had narrated a few hours before, while dominated by the personality of Wilkes.

"They took me down by the lake again," continued Ogelthorpe, "and there were the three diving units laid out on the sand with their helmets beside them. The sand was heavy and yellow and I could easily believe that it was gold, as they said.

"We decided to attempt an entry to the power plant again that night, and on Wainwright's suggestion we made a tour of reconnoissance around it. The rear of the plant ran into the mountainside; Shadow Flower said that half of it extended underground. The walls there were much lower on account of the slope of the ground, and were terraced and sculptured in a way that made them appear easily climbed."

"Could you understand the language of the crater people?" asked Dr. Feng.

"No. Wainwright did all the talking and translating. Both he and Hill declared that I had spoken the language rather fluently before I was knocked on the head. It was plain that they considered me somewhat deranged mentally. Shadow Flower labored perseveringly to teach me, but with very slight success.

"We made our attack about midnight. At nightfall the defenders of the power plant had lighted dozens of little fires on the roof and balconies, and when Hill and I started to climb the rear wall we learned what the fires were for. We were seen almost at once and welcomed by a shower of red-hot pebbles. Wainwright's rocket bullets banged and flashed spectacularly and scattered a couple of fires, but the little brown people were undaunted and swarmed everywhere on the ramparts; they had repulsed us once and probably felt that they could do it again. We retreated to cover under a heavy fire of slung stones. If we so much as stepped out of the shelter of the ferns, stones whistled all about us. Then they commenced bombarding the thicket where we were concealed and we retired from the field in a state of deep chagrin and annoyance.

"It seemed absurd that three repre-

sentatives of the dominant civilization of the twenty-first century should be held at bay by a mob of little half-naked brown people throwing stones.

"We returned to the beach and held a council of war. Wainwright reported that his ammunition was exhausted. It did not take us long to see that there was nothing that we could do then, except to wait for aid from the outside.

"Until the fourth day we sprawled moodily in our retreat under the big leaves, saying little, and scarcely bothering to change our positions when the rain leaked through on us. The crater people seemed not at all depressed by the daily rain. They went to and fro in it, wove garlands of flowers, trimmed hedges, pruned and planted, dozed in the kiosks and arbors, and awoke in swarms when the moon rose.

"On the fourth day Wainwright had his great inspiration. He leaped to his feet with a raucous yell and commenced a sort of war dance. Shadow Flower and Deep Water, who had built a little fire in a hole in the ground and were roasting us some lizard legs wrapped in tortoise fat and leaves, stared in consternation. Hill and I crossly demanded an explanation of his behavior.

"'OUR ARMOR!' he shouted. 'Our diving-armor that lies on the beach! We'll put it on and walk right up the front steps of the power plant, let the stones fly where they will! We can remove the ballast weights on the feet and legs. Even then it will be heavy, out of water, but not too heavy to walk in; thank modern metallurgy and its light alloys for that. It will be easier to put it on and *walk* it to where we want it, going in short stages with frequent rests, than to drag it. Oh, what numskulls we were, not to think of this before!'

"'What good will that do?' growled Hill. 'We can walk up to the door all right, but how shall we get in? The door has a sound lock, you know. You have a good voice. Do you propose to sing scales to it until you hit the right note?'

"'Ah, I just now thought of the solution to that problem,' replied Wainwright. 'We needn't worry about the sound lock. Wilkes brought a fulgurion from the *Grampus* and it's still on the beach with his armor. We'll blast our way in!'

"Now, before the occasion I am about to speak of, I had never seen a fulgurion in action. Very few people have, since their manufacture and use is very strictly regulated because of their concentrated power of destruction.

"A fulgurion is nothing more than a millikan-ray projector. The portable type is a short cylinder about a foot in diameter, with a pair of handles, one on each side. It looks rather like a small searchlight. There are a few artillery-size fulgurions in existence. The beam which it projects is focused at a fixed distance by a concave lens of compressed metal, and will disintegrate and fuse the most refractory substances. Air along the path of the beam is transformed into nitric oxide and ozone; water explosively dissociates into hydrogen and oxygen, which explosively reunite outside the beam.

"Our reason for bringing the fulgurion had been, according to Wainwright, that when we set out from the *Grampus* we were prospecting for gold and expected to discover a tremendous mother lode. With the fulgurion we would have blasted away the overlying rock and obtained samples of the ore."

"You had a weapon like that lying ready to hand and it was forgotten by all of you for more than three days?" demanded Osborn skeptically.

"It *was* rather silly," admitted Ogelthorpe. "But it is a historical fact that a party of shipwrecked men wandered on one of the Galapagos Islands for weeks, eating raw fish and tortoise flesh

because they believed that they had no means of making fire, until one of them discovered that he was carrying a box of matches in his shirt pocket. Such things do happen.

"Wainwright's plan roused our energy and enthusiasm immensely. Since walking to the power plant, clad in armor, would be a strenuous task, we decided to take a good night's rest and commence operations early the next morning. The afternoon we spent in overhauling the armor. We removed the ballast weights and all the radio and aerophore equipment and then essayed a short, experimental stroll along the beach. The light alloy of the remaining armor was not impossibly heavy, but it was nevertheless quite evident that we should need all our strength on the morrow. The crater people fled up the mountain or to the other side of the lake while we were doing this.

"HILL took charge of the fulgurion; I have never operated one. He turned on the low power for an instant, pointing it at the lake, to assure himself that it was in working order. There was a white flash and a bang on the surface of the lake about two hundred feet from shore, and a column of steam and water leaped into the air.

"'That was just a little sizzle,' gloated Hill. 'Just wait till I really let her howl to-morrow.'

"That evening we were lolling on the golden sand near our armor, admiring the lake and the moonlight and discussing what we would do to-morrow, when we heard the drone of propellers. We looked skyward and there was a metal drig swerving and plunging in the turbulent air high over the crater. You can imagine our excitement. We sprang to our feet and shouted.

"Wainwright thought that he might be able to talk to them with his armor radio, so we hastily reinstalled it, he wriggled in and we screwed on his helmet. It was no good; the air was a bedlam of static. We blamed it on the proximity of the power plant.

"Wainwright caught a few words of a conversation between the drig and the *Grampus* and that was all. The drig seemed trying to land, but afraid of being carried against the sides of the crater. We waved at them and they dropped a magnesium flare, hovered a while, and then hummed away into the distance. It was plain that there would be no rescue that way.

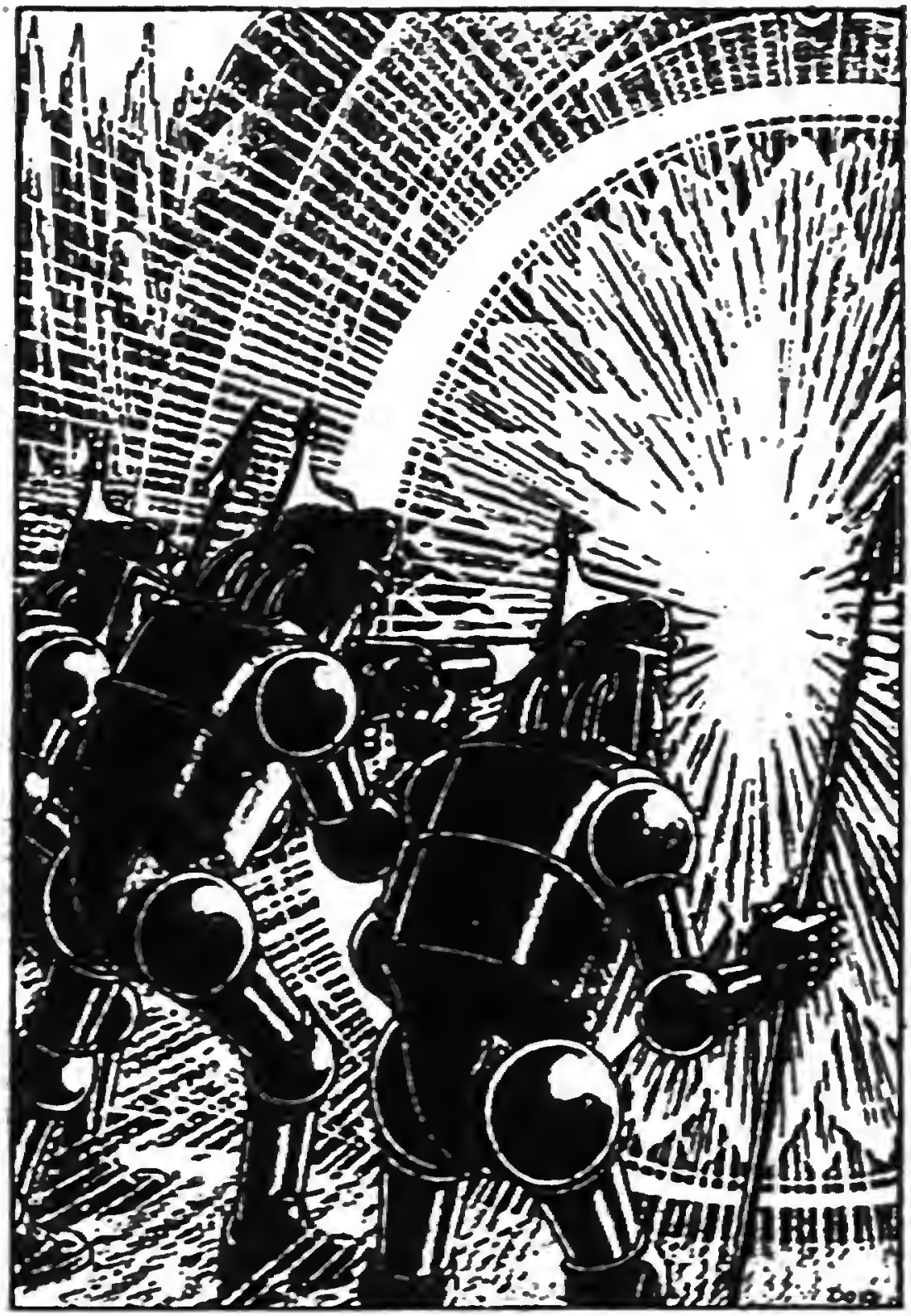
"Next morning we were awakened by being rained on. We hastily ate the breakfast that the crater people brought us and helped each other into our armor. The fulgurion was slung across Hill's armor-plated back. Our final march against the power plant had begun.

"No doubt you have heard an old musical composition entitled 'The Parade of the Wooden Soldiers.' If a composer could have heard and seen us en route he would have been inspired to write 'The Parade of the Cast-iron Dinosaurs,' or something on that order. Every time we took a step, or swung our arms, or jostled each other, there were clanks and reverberations. We could barely lift our feet. We just shuffled along on the level and when we came to a flight of steps we took them one by one, with a long pause after each one.

"Whenever we came to anything that we could sit on without falling over, we sat. Being without our usual clothes and coveralls we were in direct contact with the rough, waterproof fabric lining of the armor, which was distinctly not comfortable. We had partially filled the feet and legs with moss, which helped a little.

"A small army of crater people followed us at a distance of several hundred yards.

"WHEN we appeared on the plaza there was great excitement among our adversaries. We saw them dashing in



Then—as Hill tramped nearer and nearer—the circle contracted, glowed dazzlingly, and erupted into a shower of meteorlike globules of molten metal.

and out of doorways, hastily kindling their stone-heating fires, and collecting in crowds at every vantage point. By the time we arrived at the foot of the steps we could distinguish a shrill note of panic in their voices. Our eye ports were open.

"We began to ascend the striped steps. It was an interminable climb. A dozen times we assisted each other to sit down, sweating profusely and panting, and then assisted each other to our feet again. A slung stone clanged on my helmet, bounced off and we all closed our eye ports. The stones flew thicker as we mounted higher, whanging against our armor as on a trio of muted gongs. At last we were on the last step and confronted the great portal of overlapping white metal plates, about three hundred feet distant across a glassy pavement striped with purple, white, and gold.

"And then the real barrage of stones began. Did you ever hear a lively hailstorm falling on a sheet-iron roof? That is nothing compared to what I heard inside my armor. At first I was somewhat worried about my silicoid eye ports, but they withstood the impacts as if they were of steel.

"We halted for a breathing spell of a few moments while, with our steel-incased hands, we awkwardly assisted Hill in unlimbering the fulgurion. He deliberately raised it to position, holding it by the two handles and resting it on the boss of his breastplate.

"We advanced under a ringing hail of stones. At a distance of about two hundred and fifty feet from the portal Hill snapped on the low power of the fulgurion; its focal length was two hundred feet. You will understand that it was raining at the time, as usual. There was immediately a screech and a hiss from the air in front of the fulgurion and the cone of converging rays, two hundred feet long, became visible flickering in the midst of a cloud of steam and popping, snapping flashes of pale-blue flame from the reunion of dissociated oxygen and hydrogen.

"Little wisps of reddish-brown nitric-oxide vapors writhed around the beam. At the focal point, the tip of the cone, there scintillated a pale-blue star with darting rays of flame that barked and cracked like revolver shots; a dense cloud of the reddish-brown vapor whirled upward from it. Beyond the focal point a cone of divergent rays was dimly visible for about fifty feet, also surrounded by steam and vapors and flashes of fire.

"This farther portion of the beam was already playing upon the portal of the power plant. A small circle of the white metal about the size of the palm of one's hand, suddenly glowed red, then bright yellow, then white; and then—as Hill tramped nearer and nearer—the circle contracted, glowed dazzlingly, and erupted into a shower of meteorlike globules of molten metal that spattered over us, hissing and spitting viciously.

"Then it ceased. The beam had bored a hole through the metal and was focused directly on the hole.

"Hill turned on the full power and swept the focal point in a widening spiral. The next few seconds were almost indescribable. The beam became a solid cone of lavender light that emitted an horrific howling. The focal point was a blazing sun in a whirling cloud of gas, that screamed as it tore through the metal plates and showered us with crackling droplets. Great sections of the plates fell inward and outward, warped and crumpled and burning furiously along the edges."

"It was all over. Hill had turned off the power. I was stunned and deafened. We opened our eye ports and an immense stillness seemed to fill the world. Twisted sheets of metal lay about, sizzling and steaming under the rain. A neat semicircular archway had been

carved through the plates of the door, its margins curled back like the petals of a lily."

VIII.

"A FEW STEPS would have taken us into the power plant, but we hesitated for two reasons," Ogelthorpe continued. "For one, we needed Shadow Flower to guide us to the tunnel, and she had disappeared with the rest of our following of crater people. The sight and sound of fulgurion in action had been too much for them. Secondly, we were uncertain as to what the people in the plant would do next: Had the fulgurion terrified them into submission or would another demonstration be necessary? We wished to settle that question before removing our armor.

"Minutes passed; nothing happened. There was no sign of Shadow Flower—no sound or movement within the plant. There was no sound anywhere, except the drip and patter of the rain, or an occasional creak and clang as a fragment of hot metal cooled and contracted. We decided to remain in our armor and enter the plant without waiting longer.

"Ponderously, we clanked and shuffled through the opening that Hill had blasted with the fulgurion. Then we halted and took counsel as to our next move. We stood in a vast, high-vaulted chamber upon a glassy purple floor that mirrored everything darkly, like still water. High up in the front wall the gray daylight entered through intricate six-rayed openings shaped like snow crystals. The entire rear wall was banked with the bewildering apparatus that Wainwright likened to an automatic switchboard. It was agitated by a continual stir of small, rapid movements and little twinkling, varicolored lights; between us and it a massive, seamless partition of crystal extended from floor to roof. Flower garlands lay heaped at the base of this transparent wall. At either end of the chamber stood a cylindrical tower like a giant vacuum tube of thick glass filled with a whirling column of blue-green fire. Beyond these, twin staircases of ivory-white material curved upward out of sight around the ends of the switchboard.

"No sooner had we discovered the staircases than we perceived a stealthy movement behind the balustrade of one of them. Something was quietly descending the stair. Hill raised the fulgurion to blasting position.

"The 'something' was a little company of crater people in the last stages of fright. As soon as they came out from the shelter of the balustrade they knelt and bowed their heads to the floor. Then two of them rose and advanced tremblingly in a crouching position, each clutching some small object to his breast. The others followed crawling. Hill lowered the fulgurion with the remark that the war seemed to be over.

"When the two leaders were within a couple of yards of us they knelt again and thrust toward us along the floor the objects they had been carrying—two diminutive, covered, circular baskets.

"'There's our peace offering, whatever it is,' hazarded Bill. 'But the main question is, what have they done with our clothes? Ask them, Wainwright.'

"Wainwright complied in a majestic, oratorical voice that resounded awesomely inside his helmet. The two crater men replied falteringly and covered their faces with their hands, then opened the little baskets and held them up for us to view their contents. Their hands trembled so that the baskets wabbled.

"ONE BASKET was filled with fine gray ashes. The other contained a strange assortment of metal buttons, eyelets, nondescript pieces of wire and metal, and the remains of three watches, all much blackened and deformed.

"'Humph! Too bad, Hill,' said Wainwright. 'There are our clothes.

They've been burned—offered up on the altar and all that sort of thing. That's that. We'll go home just as we are.'

"It would do no good to repeat what Hill said.

"Obviously we no longer needed the protection of our armor, so we assisted each other to remove our helmets and then stretched ourselves on the floor and crawled out. Just as we had finished this operation we heard voices at the entrance, and turned to see Shadow Flower and several other round-eyed crater people peering in dubiously. Wainwright finally persuaded Shadow Flower to enter and commanded her to lead us to the tunnel.

"She guided us through a low archway in the center of the transparent wall in front of the switchboard and into a tubular passage of the same crystalline material. The passage plunged through an opening in the base of the switchboard, into blackness. Shadow Flower led me by one hand, I led Wainwright by the other, and he, in turn, led Hill. We went on for some distance in total darkness. A sound arose in the darkness and grew in volume as we progressed, a sustained rushing and singing like the harping of a strong wind in the rigging of a ship. But we felt no wind.

"Then there was a dim light ahead and we came out into a vast, circular chamber. Most of the light came from a faintly luminous blue disk in the center of the floor. Ranged around the walls were things—I suppose they were machines of some sort, but they suggested giant, half-human figures in sitting postures. You have seen that place in Egypt—I forget the name of it—where a pair of colossi are carved out of the side of a hill? They reminded me of that.

"Poised on the summit of each one, in the semidarkness under the roof, was a globe of tinted luminescence. The light from the globes varied, waxing and waning and ranging through all the colors of the spectrum in a complex and rhythmic harmony. There was a warmth in the air of the chamber; the floor vibrated slightly, and all around us whirled the rushing, whistling sound that we had heard in the passage—louder now but somehow muted, like a hurricane heard through thick walls.

"I thought that I saw a human figure lurking in the shadows between two of the machines, but it disappeared before I could be sure.

"We came to the luminous disk in the center and started across it. It was actually a sort of window in the floor, a disk of thick crystal over a hundred feet in diameter, and the light came from beneath. I looked down and involuntarily drew back, my brain spinning giddily. I was gazing down into a tremendous cylindrical pit that plunged to unguessable depths, dwindling to a point in breath-taking vertical perspective.

"The sides of the pit were smooth and glassy and its diameter was much greater than that of the disk. Two huge columnar conduits ascended the center of the pit, braced to the walls by titanic girders, and were diverted in opposite directions through a pair of openings in the walls of the pit a short distance below us. One conduit was black; the other glowed a soft, phosphorescent blue and was the source of the light.

"SHADOW FLOWER walked nonchalantly across the crystal disk. Our pride would not permit us to seem afraid, so we followed slowly. But at every step I felt that the transparent floor would collapse and drop us into the abyss.

"On the opposite side of the chamber we entered another Stygian passage and were led around several turns. Then Shadow Flower paused and made some remark to Wainwright. There came a click and we were momentarily blinded by intense white light.

"When our eyes had adjusted themselves to the glare we saw that we stood on a railed platform extending into a kind of shaft or well. The light came from a couple of projectors overhead that threw twin vertical beams into the depths of the shaft, beams that just grazed the edge of the platform and were so vividly white that they appeared almost solid. Shadow Flower smiled, threw open a gate in the railing, motioned downward, and spoke again.

"Wainwright almost shouted, 'The girl's stark, staring crazy! She says we're to go down there! Does she expect us to jump?'

"Shadow Flower answered his question by calmly stepping off the platform into one of the beams. In the intense brilliance she shone like a silver image and then glided downward. She did not fall; she floated down like a feather.

"For several moments we stood speechless. Then Hill declared that nothing would persuade him to risk his neck like that. Wainwright insisted that we could do it if Shadow Flower could. Presently Shadow Flower reappeared, rising buoyantly up the other beam, and stepped off on the platform. She seemed perplexed and endeavored to draw me to the edge.

"Hill said, 'Go on, Wilkes. If you survive, we'll follow.'

"I closed my eyes and stepped off into the beam, clinging to Shadow Flower's hand. For an instant I seemed to fall and then it was as if I were gripped by something firm but intangible. I opened my eyes and beheld Shadow Flower floating beside me, a figure of garish white high lights and intense black shadows. We seemed to be hanging motionless while another platform rose slowly toward us from below; when it was level with us we stepped on to it. In a few moments Wainwright and Hill arrived, like two unkempt angels descending from heaven on a ray of glory."

"Wait a minute!" interrupted Osborn. "Are you trying to tell us that you slid down a beam of light?"

"Well, so it appeared, but there must have been some other form of energy involved," declared Ogelthorpe. "It's just another thing that must be elucidated by some one more competent than I.

"This second platform projected from a blank wall of the ubiquitous purple material. There was no visible joint or crevice indicating the presence of a door. Then, instantaneously, noiselessly, the wall gaped open into a tall, elliptical archway. Shadow Flower had not moved or spoken, and it occurred to me that the way had been opened by some concealed watcher.

"WE ENTERED, and the twin light beams were extinguished. After advancing a short distance the sound of our footfalls altered as though we had left the passage and come into a large vault. Here Shadow Flower told us to halt. We waited several minutes in the darkness and silence. Although I heard nothing, I had an uneasy feeling that there was something alive there in the darkness before us, something that was stirring and awakening, opening its eyes and scrutinizing us. Wainwright must have felt the same, because his voice was nervous when presently he asked Shadow Flower why we were waiting.

"Shadow Flower replied in a hushed voice that this was the place of the Speaking Stone and that presently the Stone would speak words which it wished us to hear. Hill grumbled that he would prefer a little light while it spoke and wished that he had the fulgurion."

Ogelthorpe paused.

"Now I come to the most difficult part of what I have to tell," he said. "And if, as you say, it was a real event, it is also the most important.

"The sense of something alive and near, gradually rousing itself to action, had become so acute that I was scarcely surprised when a moving glimmer of light appeared in the darkness before us and at a considerable height above us. It was a dim, globular, crimson glow that fluttered restlessly to and fro and up and down within rather narrow limits.

"As it waxed brighter and brighter it slowly ran the gamut of the spectral colors and became surrounded by an intricate network of shining lines and polygons that shifted and changed as the light moved. By the time it had become green it was bright enough for us to see that these lines and polygons were the edges and planes of a great multifaceted block of transparent material like a huge jewel, within which the wandering light sphere was imprisoned. The jewel rested on a jet-black conical pedestal about fifty feet high.

"I had expected to see some sort of mechanical image or idol, presumably with a concealed human operator; instead, there was this purely geometrical object. Strangely enough, my sense of its aliveness, its vitality, constantly increased and all my apprehensions evaporated. The sphere's brilliance culminated in an intense violet; it contracted slightly and became motionless. I felt that it was regarding us intently, like an alert, intelligent, but friendly, eye. The jewel sparkled like an immense amethyst.

"Wainwright whispered to me brokenly, 'Wilkes! Wilkes! This unearthly thing is *alive* and it's *looking* at us!'

"THE LIGHT in the jewel leaped as though in affirmation. Then it pulsated rapidly and I became aware of—of—what shall I call it?—a silent voice. It is almost impossible to give an accurate description of what I experienced. It was somewhat like remembering. Have you ever had a long-dormant memory rise unbidden, suddenly and vividly in your mind? Have you ever seemed to hear ringing in your brain, unsummoned by any conscious process, the exact words and intonations of a remembered voice or a strain of music heard long ago? It was something like that. Words, thoughts, pictures, flowed through my mind uncontrollably and I believed, without question, that their source was the light in the jewel.

"This voice—I suppose I must call it—proceeded to elucidate itself. The builders of the power plant, it said, had created it. It was in fact the *thought* of those builders somehow recorded, imprinted, preserved in the great jewel, which was itself something only partly mechanical—'biomechanism' was the term as I understood it. This thought record was able to transmit itself to any minds coming within its radius of action, insofar as those minds were able to comprehend it. It also had a certain power of independent thought, so as to adapt its message to the recipient."

"And the builders of the power plant, who were they?" Dr. Feng asked softly.

"At first you will say that my answer is incredible," Ogelthorpe replied slowly, "but, after all, any adequate explanation of the power plant would necessarily be incredible.

"The builders of the power plant were a band of explorers from another universe. They erected it for temporary use during their investigational sojourn on our planet, much as a human explorer sets up a tent and builds a camp fire. They were the great ones from the sky mentioned by Shadow Flower. Their descent occurred in late prehistoric times; mankind was well into the agricultural phase of its development and primitive civilizations had arisen here and there over the earth.

"The great ones remained on earth perhaps several centuries. The various times that they were seen by human beings were the germs of a thousand traditions of gods and angels descending to earth and walking among men. Possibly many temples of antiquity are monuments to their apparitions. Their principal encampment in South America may have given rise to the legend of Atlantis.

"There is a current opinion that if human evolution continues in its present direction the race will become more intellectual and less emotional, with an increasing tendency to callousness and cruelty; and that if somewhere a superhuman, extraterrestrial race does exist and should some day choose to colonize the earth, it would have carried this tendency to its ultimate conclusion and would regard humanity merely as a species of vermin. The great ones were a living demonstration that neither proposition is necessarily true. In the case of human evolution it is not even probable.

"The higher we have risen above the beasts the broader has been our understanding and the deeper our sympathies, as regards both ourselves and them. This seems to have been the tendency from the dawn of humanity up to the present time, and there is no valid reason for expecting the process to be reversed in the future or for believing that present human nature is the absolute apex of the process. There will be many more advances.

"The great ones surpassed man immeasurably; their wisdom penetrated star and atom, life and death, unknown dimensions and things humanly inconceivable; yet their sympathies were as wide and deep as life. They perceived the emotions of a man or a moth as keenly and understandingly as those of their fellows; even the dim feelings of a plant were not beyond their appreciation.

"THE GREAT ONES could have transformed our little world if they had chosen, but their expedition was for the purpose of studying the worlds of our universe as they found them. A few seeds of civilization they did leave behind them, however, partly by intention and sometimes by accident. Casually discarded implements dropped here and there over the world produced myths of magic swords and hammers, sandals of swiftness, helmets and cloaks of invisibility, the Philosopher's Stone, and so forth; and the myths became a part of the growing lore of magic, alchemy, and primitive medicine. The legends of Daedalus may be dim racial memories of a series of their efforts to accelerate the progress of the human race. But the Galapagos power plant was a legacy to the humanity of the future.

"As to the nature of the power plant, the Thought Record could transmit only what our minds were capable of receiving, and none of us had the specialized knowledge necessary for complete comprehension. There may be no mind on earth that has that knowledge, although the great ones considered the plant a rough-and-ready affair for producing a small amount of energy. They installed complete automatic control before they departed and left the plant for whatever race of men might, in time, discover it and be able to understand the message of the Thought Record.

"Briefly, the power plant operates in this way: Every morning the black towers that encircle the crater become active and in some fashion induce a thunderstorm and downpour of rain, heaviest in the vicinity of the towers and diminishing toward the center of the crater. A large part of this rain drains into a great ring-shaped catch basin that also encircles the crater on an artificial terrace. From thence it flows down into the power plant and is pumped down one of the conduits in the pit that we saw, into the hot interior of the earth.

It returns up the other conduit as enormously superheated steam charged with mineral vapors, partly radioactive.

"The rain-making towers also act as collectors of atmospheric electricity, which somehow starts a process of atomic disintegration in the mineral vapors—the final products being gold and a few other elements and a great flood of energy.

"The water leaves the plant with its temperature greatly lowered, due to the highly efficient extraction of energy, carrying a number of substances in solution and finely divided gold in suspension, and drains into the ocean. The rain is automatically cut off during the afternoon, in order to allow the clouds to disperse and the sunshine to reach the vegetation in the crater; the power plant operates until the rain commences next morning by drawing on the accumulated water in the catch basin.

"The plant was built on an island because there it would be assured of a constantly humid atmosphere and an unfailing source of rain, and in a crater because there it had convenient access to an old volcanic tube and a region of subterranean heat comparatively near the surface."

"BUT if the power plant has been operating for thousands of years, as you imply, it must have produced an enormous quantity of energy," protested Osborn. "What kind of energy is it? What has become of it? Has it been wasted?"

"Positively not," affirmed Ogelthorpe. "That's the crux of the whole matter. I can't tell you what kind of energy it is. The idea which the Thought Record attempted to transmit was beyond my grasp. I apprehended it either as 'solidified electricity' or 'materialized energy'—energy in a massive, portable form from which it can be released much more easily than from the ordinary matter with which we are familiar. All this energy has been accumulated somehow in a vast, subterranean place under Indefatigable Island. And it's still accumulating. It is inclosed by some kind of barrier which can be pierced at only one point.

"I couldn't understand how this barrier is to be passed or what it is; it's just another thing that was beyond me. I can't say how much of this energy there is. I received the impression of something gigantic, something that will throw the whole world into a ferment and revolutionize earthly conditions from pole to pole. I seemed to see our race populating not one planet only, but many."

"But where do the crater people fit into the picture?" demanded Sonia. "If the plant is automatic, what need has it of attendants?"

"The great ones found the crater people living wretched and meager lives," replied Ogelthorpe. "They made the garden and set the crater people to tending it in somewhat the same spirit that we build bathing- and feeding-places for birds or establish wild-life refuges. The crater people are not, strictly speaking, power-plant attendants. Some of them keep it clean and make daily floral offerings to the machinery in a semireligious spirit. They have grown to believe that the plant is in their keeping and would not function without the offerings. There is also a workshop in the plant where they make garden implements; the great ones showed them how.

"The Thought Record could transmit very little to the minds of the crater people. They were able to understand that some day another race would discover them and the power plant, but little more than that.

"Evidently the Thought Record was aware of our fragmentary reception of its message. It urged—yes, commanded—that we bring to it other minds, minds containing the utmost of human knowledge of atomic mechanics and the

mathematics of hyperspace. For only to such minds can it transmit the secret of the power plant and the manner in which the hidden store of energy is to be tapped and utilized. The search for these minds must start immediately—now! We must broadcast it to the world——"

"NOT SO FAST!" interrupted Osborn. "There is a vast and steadily increasing quantity of gold involved in this. I fear that it will complicate matters considerably. There should be some international agreement as to its disposal before the discovery is made public; otherwise world finance will be in grave danger of——"

"We shall consider those things shortly," interposed Dr. Lemoyne. "Did this Thought Record transmit anything further?"

"No. It ceased after that," replied Ogelthorpe, "and the light slowly faded and disappeared. I don't know how long we stood there in the darkness, too astounded to move. Then Wainwright ordered Shadow Flower to show us the exit tunnel.

"We returned to the shaft. Shadow Flower turned on the twin beams, and we descended to the bottom. There we found the entrance to the tunnel and a duplicate pair of beam projectors directed upward.

"Immediately, we were faced with a difficulty. The tunnel was not provided with lights and neither were we. Shadow Flower maintained that it was quite safe to traverse in the dark, as there were no connecting tunnels or pitfalls or other dangers, but we conceived a better plan. We decided to return to our armor and remove the phosphoray lamps. Also, Hill suggested that we take the radio kit and battery from one unit and carry it with us, and endeavor to call Albemarle Island after we got outside.

"The four of us, accordingly, went up the ascending beam, one after the other. I went up last. When I had almost reached the top platform I heard an outburst of angry voices, and Hill cried, 'Look out! It's Deep Water and he's got one of our lances!'

"Then Wainwright shouted, 'Stop that crazy idiot! Where did he come from? Don't let him touch that switch.'

"Then the beams were extinguished.

"I did not seem to be falling. It seemed as though I were suspended in a black void and the air were whistling upward past me with rapidly increasing velocity. Then, abruptly, it stopped and I saw a vast explosion of fiery darts and spangles. I suppose I hit bottom then."

"Was that all?" inquired Dr. Lemoyne after a pause.

"Well—yes," hesitated Ogelthorpe. "When I opened my eyes again I was here."

"There remains one little detail," insisted Dr. Lemoyne. "Tell us."

Ogelthorpe shot him a quick, surprised glance.

"IT'S a trivial thing," said Ogelthorpe apologetically, "but an indefinite time after the impact, and before I opened my eyes, I heard a voice. It seemed to come from the ends of the earth, from an infinite distance, drawing nearer and nearer. It cried, 'Ogelthorpe, return! Ogelthorpe, return!' It seemed to be your voice, Dr. Lemoyne."

"And after that?"

"There was another voice, very faint, that wailed remotely, 'Wait! Wait! I can't get back! I can't! I can't——' and receded into silence."

Osborn started to speak, but was interrupted by the telephone buzzer, followed by a voice from the instrument.

"This is Garvin again," said the voice. "We've found our men, Osborn. Two of them are on Indefatigable Island,

about halfway up the outside of the crater. They called us by radio; they say they've been inside the crater and came out through a tunnel. The third man, Wilkes, got killed somehow. For a while he was out of his head, they say, and insisted that his name was Ogelthorpe. And your man says his name is Wilkes?"

"He doesn't now," corrected Osborn. "He is quite normal in every respect."

"Queer," remarked Garvin. "The whole affair is queer. I'll be waiting your detailed report with much interest. Good-by."

"And now," said Ogelthorpe, addressing Dr. Lemoyne, "let me have the explanation you promised me. How could I have another man's experiences? That chap on the phone just now said that Wilkes is reported dead. But it was really I who fell down the shaft, because you say that what I supposed was a dream, really happened. And yet Wilkes' body is somewhere on Indefatigable Island, a thousand miles away, and I'm here. How can that be?"

"Something very strange has occurred, involving both you and Wilkes," replied Dr. Lemoyne slowly. "There has been a temporary interchange of minds—selves—personalities, between you and Wilkes. The original interchange was in some way effected by violent shocks inflicted upon both of you at approximately the same time; the restoration was accomplished partly by hypnosis, partly by dynamic endormation."

"Modern psychology has long believed that such interchange is possible, but it has never been induced experimentally under laboratory conditions and this is the first fully authenticated instance of it, although other similar cases are believed to have occurred. Your geographical separation was evidently no obstacle to the transfer. Why this should have happened to you and Wilkes particularly, when there were doubtlessly many other apparently equally susceptible victims of shock existing here and there throughout the world at the same instant, I cannot say. It is a mystery. In such matters we find ourselves on the frontier of the unknown."

Ogelthorpe digested this for several moments.

"You brought me back—brought back my personality to the body that belongs to it," he reflected. "And Wilkes went back to his. But Wilkes is dead! Where did Wilkes go?"

"That problem is as old as the human mind," returned Dr. Lemoyne. "As to Wilkes, we can say only that he has gone—across the frontier."

THE END.

NEXT MONTH

"Galactic Patrol" by E. E. Smith, Ph. D., starts in the September issue of ASTOUNDING. Go to your news dealer now, while it's fresh in mind, and ask him to reserve your copy for you.

And please make it a point to pass the word along to your friends. In accordance with the established policy of ASTOUNDING STORIES we will never reprint "Galactic Patrol."

Remember "The Skylark"? "Skylark Three"? "Triplanetary"? "Spacehounds of the I. P. C."? and "The Skylark of Valeron"?

Five stories! Dr. Smith's entire literary production up to now! Yet he's been working on "Galactic Patrol" since 1934 and you can start reading it next month. Wesso did the September cover and illustrated the story. Don't miss it—and don't let your friends miss it.

Jack Williamson dropped into the ASTOUNDING STORIES office recently, during his first visit to New York. His home is on a ranch in New Mexico, you know. We have corresponded for years and it was like meeting an old friend. He told me how he was "doing" New York, from Coney Island to the Empire State Building and from Chinatown to Greenwich Village. His thoroughness was amazing and his keen appreciation a delight. I know now why he was able to produce stories like the "Legion of Space," and "The Cometeers." I know you'll enjoy his "Released Entropy" in this issue.

I'd like your reactions to the science article on positrons. I want to know whether to get more articles of a similar nature. Please let me have your opinions.

This year seems to be shaping up to a powerful schedule. Checking back, as I constantly do, I believe it will stand at the highest peak of interest yet attained by science-fiction. The fourth year of the new ASTOUNDING ends next month with the beginning of "Galactic Patrol." I feel that this one fact stands out like a rainbow of promise for our fifth year under the Street & Smith banner.

We have passed through momentous events. Death has ended the careers of three great science-fiction writers—Weinbaum, Daniels, and Lovecraft. But new and capable talent has been developing and is carrying on at a pace which promises great things during the coming year.

And don't forget "Galactic Patrol" starts next month. Tell your friends, and RESERVE YOUR COPY of ASTOUNDING.

The Editor.

SCIENCE DISCUSSIONS

AN OPEN FORUM OF CONTROVERSIAL OPINION

Swan Song.

Dear Mr. Tremaine (and also Miss A. R. Long):

Alas and alackaday. Here's "that man" again! Just as I had about decided to give up trying to make the world Atlantis conscious and leave the controversy I so innocently started in the capable hands of the Ph. D.'s and real scientists, I picked up your current issue and read Miss Long's diverting little yarn, *Reverse Phylogeny*. I discovered myself in the story with the name changed from White to Black and my good friends (I hope) and hecklers, the science-fictioneers, Dr. Clark and P. Schuyler Miller, transformed into a sort of composite Professor McBerlbe.

I don't know whether to sue Miss Long for libel or pin a medal on her. I only know that I laughed myself silly over the picture of Professor Miller-Clark-McBerlbe, Ph. D. under the table, making sounds like an anthropoid ape. Also, Miss Long, I thought your description of the inundation was quite graphic and if The ophelia Black was really meant to be me, you were right. I can't swim, so I probably quite definitely drowned back in 9000 B. C. If your character, Aloysius O'Flannigan, is also keen on fact and cares to experiment on me hypnotically, I shall be happy to undertake the ordeal. (Please wire transportation!) But being a landlubber, I strenuously object to the fish! However, sucker or no sucker, I think your story a gem and I sincerely hope that all the Professor McBerlbes of this enlightened (?) age read it with as much pleasure as I did. Perhaps a few of them may discover in it the handwriting on the wall.

Seriously, though, the history of Atlantis is to me no myth or fable, but the true tale of a beautiful land that no longer exists upon the earth's surface, and the story of a highly civilized people who dwelt upon the land, a people so ancient that their very memory is lost to us in the dim mists of antiquity. Their history is a most wonderful one, and has only descended to us in the form of myths and sagas, so warped and distorted that it is difficult for us to ascertain the kernel of truth that is to be found in them.

These people came to this beautiful land originally from the far-away part of the world now covered by what we call the Pacific Ocean, where they lived on the mighty continent of Mu, which the late Colonel Churchward affirms sank in 12,000 B. C. We find the remains of their mighty civilization to-day in many of the South Pacific islands. In the Marquesas, on Manga Reva/ Easter and Hawaii, there are Cyclopian evidences of their culture. But, alas, the beautiful paradise to which they eventually migrated when Mu, the motherland disappeared, is also gone, sunk beneath the mighty waters that gave it birth and which for thousands of years protected it from savage tribes and enabled it to be the cradle of our present culture and beget the colonies which arose and became mighty millenniums after it was gone.

This land was called by many names by our own ancients. The Greeks knew it as the Garden of Hesperides. The Egyptians called it the Land of Kul, the Islands of the Blessed. It was heaven to them, the racial memory of the paradise that was, and they believed the souls of their departed migrated to it after death. We know it as the Garden of Eden, and that it was finally destroyed by a mighty flood.

Its people called themselves the sons of Ad, so we, their descendants, are the sons of Adam. They called their home Adlan, the land of Ad, and the mighty surrounding sea became the Ad-lantic. They traveled from west to east to discover their new home, just as thousands of years later a man named Columbus traveled from east to west to rediscover America. The sons of Ad already knew America. They had established mighty nations in Guatemala and around Lake Titicaca in South America ages before the Incas in Peru and the Aztecs in Mexico had risen from barbarism. They were of many races and tongues, as natives of a large continent are bound to be, but they had two things in common: they worshiped the sun, called Ra-Mu; and they were mighty builders.

The sons of Ad migrated to Adlan quite gradually, over a period of some hundreds of years. In small boats, equipped with sails and oars, they traveled from island to island. Gradually many of these islands, which were of vol-

Asiatic origin, disappeared and their migrations stopped. As thousands of years passed their memory was forgotten by their descendants in Central and South America, except in myth and the meager priestly records which, as yet, we are unable to read.

Atlan was situated some three hundred miles off the west coast of Africa and Spain. It was protected from the chilling blasts of glacial Europe by high mountain ranges. The Sahara Desert was then part of a vast inland sea, the remains of which we now call the Mediterranean. The Atlas mountains were islands in that sea, much as the Azores and Canaries, mountaintops of vanished Atlan, are now islands in the Atlantic. Spain was connected with Africa at the Gibraltar Strait and England was a part of Europe. Tremendous ice fields covered the greater part of Europe and Asia, and mighty mammoths, bisons and other ferocious animals roamed that part of the land not covered by the glaciers. Prehistoric civilizations established as colonies from Mu in the Gobi and parts of Tibet were destroyed by the ice. Great climatic changes had taken place over a large portion of the earth's surface and mankind lived in caves and fought a bitter struggle for the most primitive of existences.

But in Atlan all was serene. In Atlan, protected by high mountains and warm ocean streams, man dwelt in beautiful villas and palaces, built mighty pyramids, fought no wars, had no enemies, prospered, became mighty, began sending out colonists to explore this savage, new world about them, and build the mighty empire that was theirs before their fall. Hence we see the birth of Archaic Greece, mighty Crete of the Minos, the Hawk Kings of Egypt and Etruscan Italy. We have the Cro-Magnon remains of France and the ancient Basques of Spain. And by the same token we have a garbled mythology coming down to us from some ten thousands of years before Christ, so full of supernatural monsters, gods and goddesses, dragons, chimeras, heroes, giants, etc., that it is no wonder we throw up our hands in despair and let them all go as the childish imaginings of a primitive people.

The thing we miss is the indubitable fact that these beautiful myths are impossible of conception in the mind of a savage. Distorted they may be, clothed with the fancy trappings of thousands of years of embellishment and so-called improvements, but deep down through the imaginative outer husks they are but the racial memories of a people, once civilized, who have descended to the depths of savagery because of the loss of the all-important source of their being; who have arisen again, thousands of years later, after bitter struggles, to rediscover that civilization and knowledge they'd long forgotten. Is it any wonder that their dimly remembered past had become a hazy collection of improbable fairy tales which, when waved before the eyes of modern science like the Gorgon's head, freezes their minds to stone and atrophies their intelligence?

Man, the earthling, is earthbound. As Mother Nature treats him, so his growth is recorded. When she is kind he prospers. When she is cruel he perishes, to rise again when once more she smiles upon him. Atlantis arose, became mighty and fell, all at the dictates of great geological changes in the earth's past. Who can doubt it? The changes are still occurring and will continue to occur until the end of time. Atlantis has left us no actual relic of her existence, but she has left her imprint on every nation and every people, if we but have the patience to look and the eyes to see.

So, in penning the foregoing eulogy and resume of my Atlantean theory, I write my last letter to your magazine. Others may or may not carry on. I sincerely hope they do. However, I have "shot my bolt," as the saying goes, and, as my parting swan song, may I leave these words to all the friends and friendly enemies who have written me personally and through the medium of our beloved magazine: Do not sell Atlantis short. It is our past, our Garden of Eden—as sure as God made the apples that Mother Eve ate on its fabulous shores. And that past is more beautiful than any that the mind of man has yet conceived or dreamed of. In Atlantis was paradise. Some day, God and an enlightened science willing, we may find both again.—James A. White, 606 East 3rd—Virginia Apts., Wichita, Kans.

Tektites and Consonants.

Dear Mr. Tremaine:

With regard to Herr Ley's article in the May issue, may I point out that while the illustration of the Widmanstätten structure does bear some remote resemblance to the real appearance of Widmanstätten figures, it is a far better representation of the Neumann figures, which, if I remember correctly, aren't mentioned at all in the article.

May I point out also that tektites (moldavites, australites, etc.) are not generally conceded to be meteorites, although many, myself included, have an open mind on the subject. Other theories of their origin are: (1) They are volcanic bombs from the moon; (2) They are fragments of a disrupted satellite; (3) They are terrestrial obsidian; (4) They are fragments of rock fused by the impact of huge meteorites; (5) They are masses of cosmic or terrestrial dust fused by oxidation. Probably there are some more theories, too, but all have their objections as well as points in their favor. Incidentally, the meteoritic theory seems to have been first proposed by Suess in 1900.

Disregarding tektites, there is a third type of meteorite which Herr Ley forgot. These are either a sponge of nickel-iron including nodules of olivine (pallasites), or they are a mixture of silicates including fairly large nodules of nickel-iron (mesosiderites).

On the other hand, I was very much interested in Herr Ley's discussion of bacteria in relation to meteorites. I had never thought of the possibility that anaerobes might be of extraterrestrial origin, but how about the facultative anaerobes that can work either with or without oxygen? Anyway, of the people who have cared to experiment in this direction, one claimed that he found bacteria, and the other found none. So where are we?

With regard to this Atlantis and Mu bokum, may I ask those who believe there were such places, how they account for the absolute lack of correlation between the Egyptians and the Mayas for instance, in language and physical characteristics? I'm not much of an anthropologist, so I'll let that part go, but language is one of my hobbies.

I'll concede that if any one were to take the trouble they might find even a hundred Egyptian words that sound quite a bit like Mayan words with similar meanings. But I maintain that that proves nothing, because you can do that with any pair of languages. I've seen it done with modern English and ancient Egyptian, but if you trace the English back to Anglo-Saxon, most of the alleged resemblances disappear, whereas they ought to become more pronounced. Moreover, if you compare the vocabularies of languages that really are related, you will find that laws of consonant change can be established between them. Thus "k" in Hawaiian is always "t" in Samoan and "k" in Samoan is always the hamza (') in Hawaiian.

When a certain missionary tried to prove that the Samoans, and other Polynesians, were the lost tribes of Israel, he found an imposing list of alleged resemblances between Polynesian, and various Semitic languages. But when his results were critically examined, it was found that Samoan "k," for example, might be replaced by almost any of the numerous Semitic gutturals, and similarly for each and every one of the dozen or so sounds in Samoan. Moreover, no particular change was any more frequent than any other change, so that no law existed, and his theory is now abandoned. All he had proved was that the human vocal apparatus can make only a limited number of noises, and when these are combined into words a certain number

of resemblances are bound to occur. That's the explanation of the so-called resemblances between Mayan and Egyptian, or the Greek alphabet, or what have you.

And another thing. Even if there are legitimate resemblances between two languages, relationship cannot be claimed unless there are grammatical correspondences also, because phonetic peculiarities of the languages might conceivably simulate laws of consonant change. This works the other way, also. Take Japanese and Korean for example. Japanese grammar resembles Korean grammar to a considerable degree, yet competent philologists, not just me, are all afraid to claim relationship, because the resemblances in vocabulary are few.

Now, if you publish this, I suppose some one will try to prove I'm wrong. But I have only brought up well-established laws of language, while I think most people who believe in Mu or Atlantis must have allowed the romance of the theory overshadow their better judgment. At any rate, that is the reason why I once believed in Atlantis and Mu, and Lemuria, too, until I examined the facts in the cold light of science.—John Davis Beddoe, 99 South Raymond Ave., Pasadena, Calif.

Problem in Projection.

Dear Editor:

May I call Mr. Loomis' attention to an apparent error in *The Talking Hill*? Unless my atlas is to grievous error, the Great Pyramid of Cheops is at 31° 8' east long., 29° 58' north lat., which differs considerably from the figures he gave. I was skeptical of the possibility of seeing it from the Mediterranean, but I find it is possible—in fact, theoretically, it can be seen one hundred and twenty-three miles (at least). As for the possibility of hearing the bell note five thousand miles, will you please recall, Loomis, that the upper limit of the sound energy that you broadcast to the four winds so infinitely is exactly as much as you put into the original tone. And because of the curvature of the Earth you couldn't use a focusing device. Think it over.

And, Mr. Duncan, I don't agree with your statement re the scientific knowledge of Williamson. Admittedly, he does not stick to proven fact or verified theory, but does this show he has no scientific knowledge? To me it reveals a fertile imagination, and a soul not too bound by convention. Just what do you want in a science-fiction magazine?

In taking issue with Mr. L. R. Kirton you seem to forget that a preference for Campbell or Furt is entirely a matter of personal taste. Incidentally, I think I could prove myself capable of understanding either. I think you will find the accepted view to be that J. W. Campbell's articles are intelligently prepared, and are based on modern scientific findings on the whole. Smug superiority is not the true scientific attitude.

Mr. Binder: I think you will find it well established that interplanetary space, regardless of etheric concepts, is not a vacuum, but is comparatively well populated with ions and free electrons.

Mr. Anderson: A point is 0 dimensional; a line is 1 dimensional; a plane is 2 dimensional; a solid is 3 dimensional.

A line would always cast a shadow which was a line as long as it was oblique to the direction of propagation of the light. But when the line was parallel to the direction of propagation, its shadow would be a point. Assuming, of course, a point source of light, or a source at infinity. The problem is simply an elementary one in projection.

Mr. O'Connor: No answer you have received to your question about the irresistible force and immovable mass could be quite so nonsensical as the question itself. By definition, an irresistible force is a force of such magnitude that there exists none other which can successfully oppose it. By definition, an immovable mass is a mass of such magnitude, i. e., possesses such inertia, that it cannot be moved, which implies that there exists no force great enough to move it. Which is to say its inertia (reluctance to change of position) is infinite. It is equivalent to saying, "What happens when an irresistible force meets an irresistible force?"

From the definition, you see that the existence of two such quantities simultaneously is contradictory, else there would exist a second force capable of successfully resisting the first. But if that were so, the first would not have been irresistible, which is a contradiction, since we expressly stated at the outset that it was irresistible. Hence the second could not have been irresistible.—William H. Poll, 2201 University of Kentucky, Lexington, Ky.

Attention, F. B. Long!

My dear Mr. Tremaine:

Apparently Science Discussions is destined to be a forum open to any and all scientific topics irrespective of their connection with anything having previously appeared in the text of your magazine. I approve of that policy; yet I believe that particular attention should be given to discussing the science contained within the stories themselves and that these subjects should be given preference over items which do not concern the branches of science that are to be found in science-fiction itself.

It is with that thought in mind that I undertake to point out what I believe to be an error in Frank B. Long's recent narrative, *Spawn of the Red Ghouls*. On Page 126 is to be found a statement referring to a nebula as "—revolving with such incredible velocity that its light will never reach us."

It is my opinion that Mr. Long's science is in error, and here is the basis of that belief:

Any luminous body, such as the nebula in question, will emit light rays in all directions, quite regardless of the speed of the body. The one exception is in the case of an object the speed of which is equal to, or greater than, the actual speed of light itself. Even in that case, the effect of the speed is evidenced only in those light rays which would travel directly ahead of the body were its speed lessened. It is evident that that has nothing to do with the case we are considering.

Therefore, beams of light would be emitted from the rear of the nebula (the front being in the direction of its line of flight) and they would continue toward our system at normal light speed of 186,270.75 miles per second, unless, of course, they were intercepted by objects, the positions of which prevented the light from continuing toward the solar system.

Mr. Long has, I believe, unintentionally made an error common in science-fiction: that of believing light to be affected by the speed of its source. If that were the case, we should find examples of light traveling at all speeds and even, in some cases where the speed of its source is equal to that of light, standing still!

If I have erred, I will gratefully stand corrected.—Ray A. Squires, II, 1745 Kenneth Rd., Glendale, Calif.

Is Time Eternal?

Dear Sir:

Although I disapproved of the change of your readers' department to Science Discussions, I find that it is still definitely "Brass Tacks," despite the number of interesting debates raised there.

I have a couple of ideas which I would like to give other readers the opportunity of blowing holes through.

First: I'd like to know just how much weight one gains or loses when riding in a high speed elevator, such as is in use in the Empire State Building and similar structures. For instance: suppose an ordinary bath scale

were to be placed upon the floor of the elevator. The passenger steps on it and finds that he weighs—he is a rather heavy chap—two hundred pounds. As the elevator starts upward, he is now heavier, since the acceleration allows gravity a greater hold on the subject. As the acceleration ceases—the speed, however, being greater than at the beginning—does the weight of the passenger increase, decrease, remain the same, or does he still weigh two hundred pounds, as he did before entering? Not having an elevator, a tall building, and a bath scale—not to mention a two-hundred-pounder—handy, I am forced to turn the problem over to you and your readers.

The second is a bit more complicated. Time, we know (or think), is endless, never-ending. If every hundred years the earth traveled around the sun one minute quicker than it did the preceding century, and this were kept up for some on end, the people of earth—providing they lived that long, as a race—would naturally not miss that sixty seconds out of three billion, one hundred and fifty-three million, six hundred thousand seconds. As time goes on, the centuries become successively shorter—till, a very long time hence, they are perhaps only ten years long—one tenth of what they once were. Since this change has been so gradual, and since the people of Earth have been unconsciously adjusting themselves all along, no one will know the difference except the scientists. For the present, however, we will dispense with the scientists and their instruments. Earth folk are now living ten times as fast as they were in 1937. Let us jump further into the future. The century lasts now only five years, now two, now one, now six months, now a week, a day, an hour, a minute—a second! The earth continues its race around the sun, now making its journey in split seconds. Do the Earthians continue to live as heretofore, unaware of the decrease in their year, or do they cease to exist, because time is no more? Think it over.—Richard Wilson, Jr., 86-10 117 St., Richmond Hill, N. Y.

An Entoptic Phenomenon.

Dear Editor:

The following will probably be of interest to readers of Science Discussions.

Some time ago there was a problem presented which caused some discussion among readers. If a person goes into a dark room and holds a candle in front, and to the side of, one eye, a curious phenomenon will be seen, appearing as an image. Some of the debaters argued that the image was that of the brain.

The correct scientific explanation, which was given, is that the image represented the fundus of the eye, showing the sooty shadow images of the retinal arteries and veins.

Now to my point. In perusing books on the subject, I came across an old volume of physiology, written by a Professor Yeo. He mentions the candle experiment and then says that if a person looks down the barrel of a brightly illuminated microscope, through the corner of one eye, he will see the images, this phenomenon being called Purkinje's Figures. I have performed this experiment several times, but have not witnessed the images.

However, while serving as a subject for an experimenting friend, I saw Purkinje's Figures again. The experimenter was examining my right eye, with an ophthalmoscope. On comparing notes, I found that on the image which appeared to be projected in space a foot or so away, I had listed one or two points about the fundus which he had not noted. On more attentive examination he found that I was correct. I think he called Purkinje's Figures an entoptic phenomenon.

And from my friend I learned another method of seeing the images of the retinal blood vessels. He said that if the experimenter looks at a white surface, through a small hole in a metal plate, on oscillating the aperture in rela-tionship with the pupil, once a second, the vessels will be seen as shadows on a white background. However, I have not seen the figures by this method.

I think that readers will find these experiments, which I have mentioned, very interesting to try. I should like to know how their results compare with mine, i. e., whether they see Purkinje's Figures in all the experiments, or only in one or two.—A. G. Boshell, King's College, Strand, London.

About Rockets.

Dear Mr. Tremaine:

Calling all mathematicians. . . . Calling all biochemists. . . . Help! Help! . . . Throw me out a life line of answers. Here's what got me down. Out here in west Texas we have two kinds of buttercups—flowers, you know. One kind is white and the other is yellow. Now, these flowers open up late in the evening, when it is cool, and stay open all night. Next morning, when the sun begins to "bear down" they close up. However, the yellow ones close up an hour to three hours earlier than the white ones. Why is this? Can it be that the light rays which the yellow flower absorbs turn its chemical energy into heat and cause it to wilt before the white one, which reflects more light than the yellow one and so does not get so much heat? That is the only explanation I can get. I know this question is a little alien, what with all the numbers and rocket discussions going on, but I think it will interest a lot of your readers.

Now, Mr. Isbor, I'm not saying that a rocket doesn't work on the principle of Newton's third law of motion. It does, as you've stated, and that's why it gives a more satisfactory performance in a vacuum—such as space is supposed to be—than in air. In air, when the fuel explodes, the expanding gas pushes the rocket forward, and the rocket has to overcome the resistance offered by the air. This, naturally, cuts down the speed of the rocket. In space, however, there is no resistance to overcome, so the rocket (imaginary), as you said, would go forward with the same velocity as that of the gas leaving the exhaust. In your sketches, Mr. Isbor, you drew the combustion chamber in the form of a sphere or circle, thus:

Now, the gas in the chamber exerts an equal pressure in all directions. You learned that in high-school physics. All right. Then the energy exerted by the gas pressing at points A, B, C, and D is wasted, since you want the rocket to move forward and the pressure at these points is either acting sidewise to the forward motion, as at A and B, or acting in the opposite direction, as at C and D. Theoretically then, only the pressure exerted at X, or directly in front of the exhaust tube, would be fully utilized.

Yes, you say, but the gas has got to escape, hasn't it? And won't it crowd around until it does exert pressure at X and thus be utilized? Sure, but you're going to lose a lot of speed while it's doing that. Wouldn't the rocket be much more efficient if all the gas could escape freely? It would. Then why not make the combustion chamber in the form of a cone, with the apex pointing to the fore? In such a chamber, the expanding gas would exert a *forward* pressure at all points—like the wind does when it strikes the blade of a windmill wheel, or when an airplane propeller pushes back on the air

and the air. In truth, gives the planets forward motion.—Clifton Morris, P. O. Box 216, Brownfield, Texas.

From a "Young Un."

Dear Editor:

First, I would like to congratulate Peter Ruth on his letter in the May issue. I, too, am a "young un"—fifteen years. In reply to his statement concerning a "mistake" of John W. Campbell, Jr., I say, although it is doubtful if an intelligent life exists on Jupiter, telescopes could be employed to watch the Earth by use of strong infra-red rays, to penetrate the cloud layers.

Robert J. Thompson: In your suggestion about harnessing material objects to cosmic rays, I do not see why you chose cosmic rays in particular. All of the forms of radiation of the electromagnetic spectrum travel at the same rate of speed: 186,284 m.p.s., by the latest revision. Hit-or-miss—maybe by some kink of Millikan's theories, cosmic rays could be harnessed by matter. Millikan thinks that cosmic rays are the energy used in the very creation of matter. Get the idea? Although if this were possible, what about the results of motion at the speed of light? If anybody has some thoughts on the subject, don't hesitate to fire away.

Tex McGee: I would like to know how you propose to "lighten the beam" by means of high-frequency rays. Of what rays is your beam composed? Maybe I'm too inquisitive.—Kenneth A. Bilon, 7905 Minor Lane Boulevard, Omaha, Nebr.

Figure This Out!

Dear Editor:

May I mention to D. D. Sharp that it is impossible for two children of the same parents to have the same environment? Child A is a part of the environment of Child B and B is a part of the environment of A. As A differs from B, as will A's environment differ from B's environment, and whatever opportunities or contingencies the one may offer the other must serve to alter the other. Only a race of identical twins would show a departure from this rule, but in such race there is no real departure, as one twin is precisely like the other (unless they be of opposite sexes, in which case . . . !!!x???). It's the same old battle.—C. B. Loomis, Manhattan Beach, Calif.

Page Mr. Loomis.

Dear Mr. Tremaine:

As you remember, from a previous letter of mine, I liked Bertell Loomis' The Talking Fish. I thought his article quite original. I had never seen much theories as to the use of the Great Pyramid in print before. I compared his figures as far, figuring the fellow ought to know what he was talking about. I admit that I had read accounts and descriptions of the Great Pyramid before, but I did not remember the dimensions, if any were given.

But what did I find in Science Discussions? A letter—a lengthy and very complete one at that—from one of my countrymen: Sutherland Markham, of Toronto. He took Mr. Loomis to task very severely for printing many alleged mistakes. In other words Mr. Loomis was very politely, but in no uncertain words nonetheless, called a spinner of bigger and better fish stories.

"Wow!" I thought to myself. "What have we here? Loomis seems certain of himself: as does this Markham guy. But the two don't agree. Now, why?"

After this, I decided that I'd do a little research work of my own, in the local library, and see what dirt I could dig up on the subject. What I found bears out Markham's statements, and I am sorry to say, also called Loomis a spinner of fish stories.

For the first thing, the height: Loomis says it was over 500 feet high. Markham says it was 484 feet 11.39 inches high. In the books I looked through the measurement given was 481.4 feet high—much closer to Markham's measurement than to Loomis'.

But Markham didn't mention the base line. Loomis says it was 728 feet, or so. I found it is between 763 and 736 feet!

Loomis says the pyramid was built of 20-ton blocks of stone. The heaviest weight I could find for these enormous blocks was not 20 tons, but 2½ tons! Quite a difference there!

By the way, it is calculated that the whole thing weighs in the neighborhood of 4,883,000 tons.

The only fact that these books gave me that agreed with Loomis was that the structure covered approximately 13 acres.

Well, now that I have rid myself of that burden, I'll crawl off into my hole, from which I will contemplate the world with dreamy happiness until I see fit cause to worry the "mail" with another letter to Science Discussions.—Leslie A. Cranerth, Woodcock St., Perry Sound Ontario, Canada.

Jumping Explained.

Dear Editor:

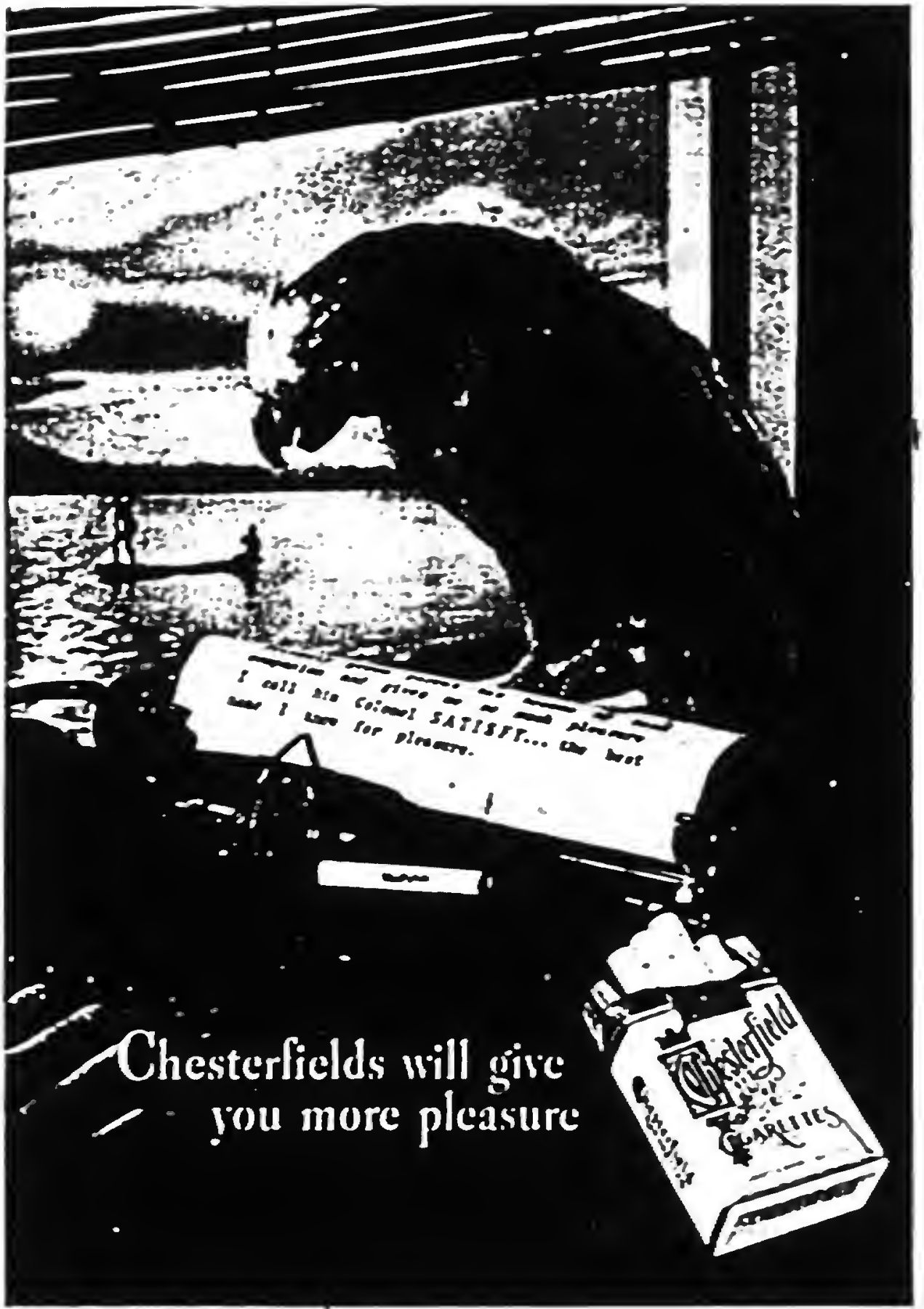
Mr. Miller's theory of jumping on other planets is sound physics, but the technique of jumping is not so simple as he assumes. On Earth, a good high jumper can clear six feet. But no man can reach anything like that height standing up. If a man six feet tall clears the bar at six feet, he does so horizontally. Only his feet (as you intended) rise six feet. His head does not rise at all, and his center of gravity is lifted only about three feet. This three feet is all he actually jumps, and it is all that is affected by gravity: the rest is simply a question of his own height.

Then on the Moon, with one sixth the Earth's gravity, he could clear $3 \times 6 + 3 = 21$ feet.

In the broad jump, the vertical velocity cannot be equal to the horizontal, because the latter has been worked up by a long run, and the jumper has no means of converting the one velocity into the other. Photos show that a broad jumper clearing twenty-four feet reaches a height of about six feet, but, like a high jumper, by doubling up his body. In fact, while the distance depends on the height, the height is more or less independent of the horizontal speed. In the broad jump, a man goes nearly as high as in the high jump.

Then, on the Moon, our broad jumper—assuming he takes off at the same speed as on Earth—will reach a height of about twenty-one feet. As Mr. Miller shows, if his horizontal speed equaled his initial vertical, his distance would be four times his height. But we have seen that it is greater. As altitude varies as the square of the speed, his horizontal speed will be about 1.4 times his initial, increase of forty-four percent in height (120:100 squared = 144:100). Then the Lunar pole-vault record should be about one hundred and thirty-five feet!

If a sprinter's strides are ten feet on the Earth, they would be not much more than three feet on Jupiter, so that he would be really walking. As he could not take many more strides a second than on Earth, his speed would be about one third of what he could make on earth. Or, say, eight miles an hour. At this speed, and allowing for gymnastics, the Jovian broad jump record would be about five or six feet, the pole-vault record about the same.—Charles A. Baker, Jr., Bound Brook, N. J.



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